

# iSTEM Module 14

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## BIOMEDICAL INNOVATION

### The Ampcontrol Emergency Ventilator Project



Health



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#### SUMMARY

In this module students develop skills and understanding associated with biomedical innovations and how an Australian business Ampcontrol responded in supporting the NSW Department of Health at the height of COVID-19 in Australia.

Students will immerse themselves in a real-world scenario to developing skills and understanding on how biomedical innovations are created through applying the STEM process to create solutions in a global crisis during the COVID-19 pandemic.

Students will address the inquiry question of “How can Australian Industry contribute to Biomedical Innovation?”. Students will build knowledge and understanding around biomedical concepts and engage in guided research and investigation processes Ampcontrol undertook to create a medical solution for NSW Health during the pandemic outbreak.

## STEM Process Unit Planning

STAGE 5   iSTEM   Module 14: Biomedical Innovation	
Scope and Sequence of Learning Activities/ Experts- Guide Only	Duration
Students will be required to complete a progressive engineering report and present a prototype basic ventilation system which will assist people affected by COVID-19.	10 Weeks - 25 Indicative hours
Topic 1: Introduction to Ampcontrol and COVID-19	Topic 1: 1 Week
Topic 2: Lung volume, respiratory rate, inspiratory-expiratory ratio	Topic 2: 2 Weeks
Topic 3: Lung compliance	Topic 3: 2 Weeks
Topic 4: Building a ventilation system	Topic 4: 4 Weeks
Topic 5: Presentation and engineering report	Topic 5: 1 Week

## Unit overview

In this module students develop skills and understanding associated with biomedical innovation, specifically design of a medical innovation and biomedical engineering.

In this module, students are to develop skills and understanding associated with a biomedical innovation. Students will utilise inquiry and problem-based learning strategies to investigate the worldwide pandemic COVID-19, which has affected the way we live and medically treat patients who have contracted the virus. Students roleplay as engineers who have been approached by NSW Health to investigate and design a basic biomedical ventilation system, to assist the increased demand for respiratory care and support for the increasing number of patients requiring medical support.



### iSTEM Outcomes

- 5.1.1 Develops ideas and explores solutions to STEM based problems
- 5.1.2 Demonstrates initiative, entrepreneurship, resilience and cognitive flexibility through the completion of practical STEM based activities
- 5.2.1 Describe how scientific and mechanical concepts relate to technological and engineering practice
- 5.2.2 Applies cognitive processes to address real world STEM based problems in a variety of concepts
- 5.3.1 Applies a knowledge and understanding of STEM principles and processes
- 5.3.2 Identifies and uses a range of technologies in the development of solutions to STEM based problems
- 5.4.1 Plans and manages projects using an iterative and collaborative design process
- 5.4.2 Develops skills in using mathematical, scientific and graphical methods whilst working as a team
- 5.5.1 Applies a range of communication techniques in the presentation of research and design solutions
- 5.5.2 Critically evaluates innovative, enterprising and creative solutions
- 5.6.1 selects and uses appropriate problem solving and decision making techniques in a range of STEM contexts
- 5.6.2 Will work individually or in teams to solve problems in STEM contexts
- 5.7.1 demonstrates an appreciation of the value of STEM in the world in which they live
- 5.8.1 Understands the importance of working collaboratively, cooperatively and respectfully in the completion of STEM activities

### Skills

Students learn about:	Students learn to:
14.1 Biomedical Innovation: <ul style="list-style-type: none"> <li>▪ Applying the process</li> <li>▪ Designing</li> <li>▪ Researching</li> <li>▪ Investigating</li> <li>▪ Communicating</li> <li>▪ Managing projects</li> <li>▪ Evaluating</li> </ul>	<ul style="list-style-type: none"> <li>▪ Use a process to develop solutions to biomedical related problems</li> <li>▪ Design investigations that allow valid and reliable data and information to be collected</li> <li>▪ Use appropriate technologies and strategies for data collection or gathering information</li> <li>▪ Collect, analyse and apply the results of research and investigation</li> <li>▪ Produce solution to problems related to biomedical</li> <li>▪ Manage the development of a biomedical project</li> <li>▪ Effectively communicate solutions to problems</li> <li>▪ Evaluate processes and solutions to biomedical problems</li> </ul>



## Technologies

Technologies	
Students learn about:	Students learn to:
14.2 Biotechnologies <ul style="list-style-type: none"> <li>▪ Range of technologies used in biotechnology</li> </ul>	<ul style="list-style-type: none"> <li>▪ Describe a range of technologies used in developing biomedical solutions</li> <li>▪ Perform experiments using a range of technologies to solve biomedical related problems</li> <li>▪ Use appropriate technologies for collecting data including data loggers and sensors</li> <li>▪ Use technologies typically used in the biosciences</li> <li>▪ Assesses the impact of new technologies on biomedical engineering</li> </ul>

## STEM Principles and Processes

STEM Principles and Processes	
Students learn about:	Students learn to:
14.3 Biomedical innovation concepts <ul style="list-style-type: none"> <li>▪ Biomedical innovations</li> <li>▪ Design and engineering processes</li> <li>▪ Environmental health</li> <li>▪ Bioengineering</li> <li>▪ Scope and nature of biomedicine</li> </ul>	<ul style="list-style-type: none"> <li>▪ Use biomedical processes to develop solutions to problems</li> <li>▪ Utilise biomedical principles to evaluate current and emerging bioengineering solutions</li> <li>▪ Describe solutions to biomedical and/or bioengineering problems</li> <li>▪ Solve problems using forensic science methods</li> <li>▪ Explain how biomedical innovation has been able to solve environmental issues that have impacted human health</li> <li>▪ Develop an understanding of the scope and nature of the biomedical professions</li> </ul>

## Mechanics

Mechanics	
Students learn about:	Students learn to:
14.4 Analysis: <ul style="list-style-type: none"> <li>▪ Statistics</li> <li>▪ Using data to develop evidence-based arguments and conclusions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Use mathematical, scientific and/ or graphical method as to solve biomedical related problems</li> <li>▪ Analyse data using statistical methods to develop evidence-based arguments and conclusions for biomedical based problems</li> <li>▪ Undertakes investigation to collect valid and reliable data and information, individually and collaboratively</li> </ul>

## Problem Solving &amp; Design

Problem Solving & Design	
Students learn about:	Students learn to:
14.5 Designing solutions to biomedical problems	<ul style="list-style-type: none"> <li>▪ Apply an appropriate design process to design solutions to identified problems related to biomedicine</li> </ul>



ICT and Digital Technology	Resources
<ul style="list-style-type: none"> <li><input type="checkbox"/> Micro:bits</li> <li><input type="checkbox"/> Coding via onlinegdb.com</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Video: <a href="#">Channel 9 COVID-19 Headline</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol VIDEO 1: Introduction with Tiana and Ruvimbo</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol DEMONSTRATION: Lung Volume</a></li> <li><input type="checkbox"/> Activity Guide: <a href="#">Measuring Lung Volume – investigation activity and worksheet</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol VIDEO 2: Chris Bird – Research Methodology</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol VIDEO 3: Mikhaila Halford – Learning and Development Specialist</a></li> <li><input type="checkbox"/> Video: <a href="#">Information from Department of Health</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol VIDEO 4: Michael Cotton – Electrical Technician</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol DEMONSTRATION: Breaths per minute and Inhale : Exhale ratio</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol VIDEO 5: Thomas Steigler – Research Engineer</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol VIDEO 6: Ryan Boyle – Product Engineer</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol VIDEO 7: Ian Webster– Group Engineering Manager</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol VIDEO 8: Aaron Breese – Control and Systems Engineer</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol DEMONSTRATION: Pump Assembly</a></li> <li><input type="checkbox"/> Video: <a href="#">Ampcontrol Video: And that is a wrap</a></li> <li><input type="checkbox"/> Video: <a href="#">How ventilators work</a></li> <li><input type="checkbox"/> Website: <a href="http://www.onlinegdb.com">www.onlinegdb.com</a></li> <li><input type="checkbox"/> Website: <a href="http://www.microbit.org">www.microbit.org</a></li> </ul>



Key Inquiry Questions and Drive Engineering Question	Curriculum Priorities and Key Capabilities
<p><b>KEY INQUIRY QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How can Australian industries contribute to biomedical innovation?</li> <li>How can Australia work with other countries to resolve the COVID-19 quickly?</li> </ul> <p><b>DESIGN PRODUCTION DRIVE QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How do we create a system that supports breathing?</li> <li>What medical considerations need to be incorporated when designing a respiratory system?</li> <li>What materials can the system be created out of which are readily available and sustainable?</li> </ul>	<p>Highlighted are the general capabilities which apply to this unit:</p> <ul style="list-style-type: none"> <li>Critical and creative thinking</li> <li>Ethical understanding</li> <li>Information and communication technology capability</li> <li>Intercultural understanding</li> <li>Literacy</li> <li>Numeracy</li> <li>Personal and social capability</li> </ul> <p>Highlighted are the cross-curriculum priorities which apply to this unit:</p> <ul style="list-style-type: none"> <li>Aboriginal and Torres Strait Islander histories and cultures</li> <li>Asia and Australia's engagement with Asia</li> <li>Sustainability</li> </ul>

Assessment overview ( Skills highlighted to be assessed in second column)	Cognitive Skills (Visible Learning skills to be assessed in highlight)
<p><b>SUMMATIVE PRE-ASSESSMENT OF LEARNING</b></p> <p><b>Lesson 1 – Survey/discuss</b></p> <p>Students are to complete a pre-survey/discussion with students to demonstrate their prior knowledge of;</p> <ol style="list-style-type: none"> <li>Australian industries contributing to biomedical innovation</li> <li>Their understanding of what biomedical innovation is and how it assists society</li> <li>How COVID-19 has affected the health systems and what detriment that has occurred as a result</li> <li>What skills they can bring to a biomedical experimentation and design</li> </ol> <p><b>ONGOING ASSESSMENT FOR LEARNING</b></p> <p><b>Each Topic - Experimentation and justification</b></p> <p>Throughout the topics, students are provided opportunities to investigate, research, experiment and justify their decisions towards creating a biomedical prototype.</p>	<p><b>Pose Questions:</b> is to raise a question, to bring attention to a problem. It does not have to be directed to a specific person and cannot always be answered immediately</p> <p><b>Analyse:</b> consider all parts in order to explain and interpret it, for the purpose of finding meaning or relationships and identifying patterns, similarities and differences</p> <p><b>Apply:</b> use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation</p> <p><b>Justify:</b> give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable</p> <p><b>Conduct:</b> Direct in action or course; manage; organise; carry out</p> <p><b>Consider:</b> Think deliberately or carefully about something, typically before deciding; take something into account when making a judgment; view attentively or scrutinise; reflect on:</p> <p><b>Collaborate:</b> Work jointly on a project</p>



Assessment overview ( Skills highlighted to be assessed in second column)	Cognitive Skills (Visible Learning skills to be assessed in highlight)
<p>Students are to demonstrate their understanding of the outcomes using;</p> <ul style="list-style-type: none"> <li>- <b>ISTEM: Module 14 Biomedical innovation - Student workbook</b></li> </ul> <p><b>TEACHER OBSERVATIONS OF COLLABORATION WORKING DURING DESIGN PRODUCTION</b></p> <p><b>Formative:</b></p> <p>Observations during each lesson of the following;</p> <ul style="list-style-type: none"> <li>- Student collaboration while applying the STEM Process</li> <li>- Student skills working independently and collaboratively during experimentation</li> <li>- On-going completion and application of their student workbook, communicating in multifaceted ways</li> </ul> <p><b>Summative Final Assessment of learning:</b></p> <p><b>Final Report</b></p> <ul style="list-style-type: none"> <li>- Completion and application of their final report and modification to improve a biomedical innovation, demonstrating their knowledge, understanding and application of outcomes learnt over the duration of the unit</li> </ul> <p><b>HOW DO I APPLY THE ISTEM PROCESS?</b></p> <p>Students will:</p> <ul style="list-style-type: none"> <li>• Identify and define the need</li> <li>• Apply knowledge and understanding to recognise and outline the constraints to guide the final result</li> <li>• Analyse existing solutions and brainstorm modifications or new ideas</li> <li>• Collaborate to research and plan a solution</li> <li>• Develop and make a solution to clearly represent the annotated plan</li> <li>• Test and improve the model against the class design; does it fit? Have I met the constraints? Is the model sustainable?</li> <li>• Evaluate, share and communicate: Reflect on processes and final solution to the initial problem. Demonstrating students understanding of the design need and progress through the STEM process.</li> </ul>	<p><b>Communicate/ Share:</b> convey knowledge and/or understandings to others; make known; transmit</p> <p><b>Create:</b> bring something into being or existence; produce or evolve from one's own thought or imagination</p> <p><b>Define:</b> give the meaning of a word</p> <p><b>Describe:</b> give an account (written or spoken) of a situation, event, pattern or process, or of the characteristics or features of something</p> <p><b>Discuss:</b> debate; talk or write about a topic, including a range of arguments, factors or hypotheses</p> <p><b>Explore:</b> look into both closely and broadly; scrutinise; inquire into or discuss something in detail</p> <p><b>Generate:</b> produce; create; bring into existence</p> <p><b>Identify:</b> distinguish; locate, recognise and name; establish or indicate who or what someone or something is</p> <p><b>organise:</b> arrange, order; form as or into a whole consisting of interdependent or coordinated parts</p> <p><b>Measure:</b> ascertain the size, amount, or degree of (something) by using an instrument or device marked in standard units.</p> <p><b>Recognise:</b> identify (someone or something) from having encountered them before</p> <p><b>Predict:</b> suggest what may happen based on available information</p> <p><b>Recognise:</b> identify or recall particular features of information from knowledge;</p> <p><b>Reflect on:</b> think about deeply and carefully</p> <p><b>Use:</b> apply knowledge or rules to put theory into practice</p> <p><b>Plan:</b> a detail proposal</p>



Assessment overview ( Skills highlighted to be assessed in second column)	Cognitive Skills (Visible Learning skills to be assessed in highlight)
<p>Students will showcase their final products and invite experts to share their learning.</p> <p><b>Audience:</b> Class, stage group, school community, Central Coast Academy of STEM Excellence, families, the wider community, Ampcontrol / industry.</p> <p><b>SAMPLE REPORTING DESCRIPTOR:</b> <i>The student investigates and explain how respiratory systems can assist people when they contract COVID-19</i></p>	






## BIOMEDICAL OUTCOME TRACKING GRID

iSTEM: Module 14 Biomedical	OUTCOMES	5.1.1 Develops ideas and explores solutions to STEM based problems	5.1.2 Demonstrates initiative, entrepreneurship, resilience and cognitive flexibility through the completion of practical STEM based activities	5.2.1 Describe how scientific and mechanical concepts relate to technological and engineering practice	5.2.2 Applies cognitive processes to address real world STEM based problems in a variety of concepts	5.3.1 Applies a knowledge and understanding of STEM principles and processes	5.3.2 Identifies and uses a range of technologies in the development of solutions to STEM based problems	5.4.1 Plans and manages projects using an iterative and collaborative design process	5.4.2 Develops skills in using mathematical, scientific and graphical methods whilst working as a team	5.5.1 Applies a range of communication techniques in the presentation of research and design solutions	5.5.2 Critically evaluates innovative, enterprising and creative solutions	5.6.1 selects and uses appropriate problem solving and decision making techniques in a range of STEM contexts	5.6.2 Will work individually or in teams to solve problems in STEM contexts	5.7.1 demonstrates an appreciation of the value of STEM in the world in which they live	5.8.1 Understands the importance of working collaboratively, cooperatively and respectfully in the completion of STEM activities
Program Topic Areas	Evidence														
TOPIC 1: Introduction to Ampcontrol and COVID-19	Define and Think	X	X		X	X						X		X	
	Constraints		X		X	X		X				X			X
	Brainstorm	X	X		X	X	X			X		X	X		X
	Research and Plan	X	X	X	X	X	X	X	X	X		X	X		X
	Develop and Make	X	X	X	X	X	X	X	X	X		X	X		X
	Test and Improve	X	X	X	X	X	X	X	X	X		X	X		X
	Evaluate and share	X	X	X	X	X	X		X	X	X	X	X	X	X
TOPIC 2: Lung Volume, respiratory rate, inhale:exhale ratio	Define and Think	X	X		X	X						X		X	
	Constraints		X		X	X		X				X			X
	Brainstorm	X	X		X	X	X		X	X		X	X		X
	Research and Plan	X	X	X	X	X	X	X	X	X		X	X		X
	Develop and Make	X	X	X	X	X	X	X	X	X		X	X		X
	Test and Improve	X	X	X	X	X	X	X	X	X		X	X		X
	Evaluate and share	X	X	X	X	X	X		X	X	X	X	X		X
	Develop and Make	X	X	X	X	X	X	X	X	X		X	X		X
	Test and Improve	X	X	X	X	X	X	X	X	X		X	X		X
Evaluate and share	X	X	X	X	X	X		X	X	X	X	X	X	X	X
TOPIC 3: Lung compliance	Define and Think	X	X		X	X						X		X	
	Constraints		X		X	X		X				X			X
	Brainstorm	X	X		X	X	X			X		X	X		X
	Research and Plan	X	X	X	X	X	X	X	X	X	X		X	X	



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Program Topic Areas	Evidence															
	Develop and Make	X	X	X	X	X	X	X	X			X	X		X	
	Test and Improve	X	X	X	X	X	X	X				X	X		X	
	Evaluate and share	X	X	X	X	X	X	X		X	X	X	X	X	X	
TOPIC 4: Building a Ventilation System, Presentation and Engineering Report	Define and Think	X	X		X	X						X		X		
	Constraints		X		X	X		X				X			X	
	Brainstorm	X	X		X	X	X			X		X	X		X	
	Research and Plan	X	X	X	X	X	X	X	X	X		X	X		X	
	Develop and Make	X	X	X	X	X	X	X	X			X	X		X	
	Test and Improve	X	X	X	X	X	X	X					X	X		X
	Develop and Make	X	X	X	X	X	X	X	X				X	X		X
	Test and Improve	X	X	X	X	X	X	X					X	X		X
	Evaluate and share	X	X	X					X		X	X	X	X	X	X
Outcomes Achieved		29	33	21	32	32	21	25	17	13	4	33	25	8	29	
Documentary PTS Total		322														





Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
14.1 Biomedical Innovation - applying processes - investigating 14.3 Biomedical innovation - scope and nature of biomedicine	- Use a process to develop solutions to biomedical related problems - Develop and understanding of the scope and nature of the biomedical professions		<p><b>TOPIC 1: INVESTIGATION INTO LUNG VOLUME</b></p> <p><b>DEFINE the problem</b></p> <p>How do lungs work and how can you determine an individual's lung volume to assist their breathing when they have contracted COVID-19?</p> <p><b>Introduction:</b></p> <p><b>Provide a DIGITAL Copy of the <i>STUDENT WORKBOOK &amp; FINAL BIOMEDICAL REPORT TEMPLATE</i></b></p> <ul style="list-style-type: none"> <li>- Overview of the STEM Process application</li> </ul> <p><b>Watch:</b></p> <p><b>VIDEO:</b> <a href="#">COVID-19 Pandemic Headline</a></p> <p><b>Watch:</b></p> <p><a href="#">Ampcontrol Video 1: Introduction – Tiana and Ruvimbo</a></p> <p><b>Back story:</b></p> <p>“You are a Biomedical Engineer working at Ampcontrol and your supervisors have just called you in to their office. They inform you that you will be a part of one of the teams working to develop a new ventilator in response to COVID-19. The time frame is very tight and you will be required to work quickly and accurately. You and your team have never faced such a problem and the following lessons have been designed to give you the relevant knowledge and skills to undertake the task you have been assigned.</p> <p>In this lesson you will be required to investigate the lung volume, breaths per minute and Inhale: Exhale ratio of a</p>		




Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
			<p>human being. You will also need to deduce the relevance and significance of your findings.”</p> <p><b>THINK</b></p> <ul style="list-style-type: none"> <li>- What is lung volume?</li> <li>- Why would lung volume be important to know in the design of a respirator?</li> <li>- Students provided with the assessment</li> </ul> <p><b>Explain the ‘Problem’</b></p> <ul style="list-style-type: none"> <li>o High level of casualties being admitted to hospitals and minimal amount of respirators</li> <li>o Students are novice engineers with minimal knowledge of biomedical respiratory systems and/ or lung operation</li> </ul> <p><b>Watch:</b></p> <p><a href="#">Amcontrol Video 2: Chris Bird – Research Methodology</a></p> <ul style="list-style-type: none"> <li>o Discuss existing solutions / reasons why this is not currently meeting the need/demand?</li> <li>o What does a product development manager do?</li> <li>o What research was needed to be done with regards to the Emergency ventilation system?</li> </ul> <p>Topics you will learn about are:</p> <ul style="list-style-type: none"> <li>▪ Lung volume</li> <li>▪ Lung compliance</li> <li>▪ Lung resistance</li> </ul>		






Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
			<ul style="list-style-type: none"> <li>○ What types of questions need to be asked? (Comparative)</li> <li>○ What do students already know about the context/issue?</li> <li>○ What information will need to be gathered/ investigated to better understand the problem?</li> </ul>		
14.5 Designing solutions to biomedical problems	- Apply an appropriate design process to design solutions to identified problems related to biomedicine		<p><b>CONSTRAINTS</b></p> <p>Discuss as a class and outline the constraints for the task</p> <ul style="list-style-type: none"> <li>- Time / cost / size</li> <li>- Testing guidelines</li> <li>- Discuss student skill and experiences</li> <li>- An individual's lung volume</li> </ul> <p>Materials provided:</p> <ul style="list-style-type: none"> <li>- Balloon</li> <li>- Measuring tape</li> <li>- Stopwatch</li> </ul>		
14.1 Biomedical Innovation - applying processes - investigating - communicating - managing projects	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Design investigations that allow valid and reliable data and information to be collected</li> <li>- Use appropriate technologies and strategies for data collection or gathering information</li> </ul>		<p><b>BRAINSTORM</b></p> <p>In pairs, small groups or as a class brainstorm the following questions;</p> <ol style="list-style-type: none"> <li>1. How could you measure Lung volume with the materials provided?</li> <li>2. Is the lung volume of each person the same? Justify your answer.</li> <li>3. How could you if each person's lung volume is the same?</li> <li>4. What apparatuses are existing that are easily made?</li> <li>5. How to determine an average, fair testing and volume?</li> </ol>		




Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
	<ul style="list-style-type: none"> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> </ul>		<p>Were there other questions generated from the discussion?</p> <p>Unpack these brainstormed topics to determine what is most significant to further research</p>		
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- Designing</li> <li>- Researching</li> <li>- investigating</li> <li>- communicating</li> <li>- managing projects</li> </ul>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Design investigations that allow valid and reliable data and information to be collected</li> <li>- Use appropriate technologies and strategies for data collection or gathering information</li> <li>- Collect, analyse and apply the results of research and investigation</li> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> </ul>		<p><b>RESEARCH AND PLAN</b></p> <ul style="list-style-type: none"> <li>- Research brainstormed areas and other questions student have to build understanding.</li> <li>- Plan how to measure and determine how to collect data when measuring an individual's lung volume</li> <li>- Create two groups: Control and variable/experimental</li> </ul> <p><b>WATCH:</b></p> <p><b>Amcontrol DEMONSTRATION:</b> Lung volume</p> <ul style="list-style-type: none"> <li>- Plan scientific procedure to measure lung volume</li> </ul> <p>Video: <a href="#">Sample Investigation Procedure – Measure lung Volume</a></p> <ul style="list-style-type: none"> <li>- Make predications for testing outcomes</li> <li>- Document results and conclusions in the student book</li> </ul>		



Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
14.1 Biomedical Innovation - applying processes - Designing - managing projects 14.5 Designing solutions to biomedical problems	- Use a process to develop solutions to biomedical related problems - Produce solutions to problems related to biomedical - Manage the development of a biomedical project Apply an appropriate design process to design solutions to identified problems related to biomedicine		<b>DEVELOP AND MAKE</b>  <b>ACTIVITY 1 – Lung Volume Investigation</b>  - Collaborate and conduct experimentation of lung volume within control / variable groups - Collate findings of scientific experiment - Graph results of number of breaths vs volume of air in balloon		-
14.1 Biomedical Innovation - applying processes - investigating - managing projects - evaluating	- Use a process to develop solutions to biomedical related problems - Manage the development of a biomedical project - Effectively communicate solutions to problems - Evaluate processes and solutions to biomedical problems		<b>TEST AND IMPROVE</b>  - Collate, analyse and reflect results and compare findings between groups - Improve procedure where possible - Discuss how a person with COVID-19 could be adversely affected during this type of testing		
14.1 Biomedical Innovation - applying processes - communicating - evaluating	- Use a process to develop solutions to biomedical related problems - Manage the development of a biomedical project		<b>EVALUATE AND SHARE</b>  - Did you choose and appropriate method of collating and documenting the data? <b>Limitations</b> - Is the lung capacity of each person testing the same?		



Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
<p>14.4 Analysis: - Statistics Using data to develop evidence-based arguments and conclusions</p>	<ul style="list-style-type: none"> <li>- Effectively communicate solutions to problems</li> <li>- Evaluate processes and solutions to biomedical problems</li> <li>- Use mathematical, scientific and/ or graphical method as to solve biomedical related problems</li> <li>- Analyse data using statistical methods to develop evidence-based arguments and conclusions for biomedical based problems</li> </ul> <p>Undertakes investigation to collect valid and reliable data and information, individually and collaboratively</p>		<ul style="list-style-type: none"> <li>- How could the lung volume be measured with the materials provided?</li> <li>- Are there any highlighted similarities / differences of;                             <ul style="list-style-type: none"> <li>o Lung capacity for each student</li> <li>o Male vs female students</li> <li>o age</li> <li>o students with lung / breathing conditions</li> </ul> </li> <li>- Significance and relevance of the data when designing a respiratory system</li> <li>- Compare and justify the data between groups and discuss variables</li> </ul> <p><b>TASK:</b></p> <p>Complete work and findings in:</p> <p><b><i>STUDENT WORKBOOK &amp; FINAL BIOMEDICAL REPORT TEMPLATE</i></b></p> <ul style="list-style-type: none"> <li>- Begin a report including the findings from the experiment to contribute to final report for design production – use template supplied</li> </ul>		


Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- investigating</li> </ul>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Develop and understanding of the scope and nature of the biomedical professions</li> </ul>		<p><b>TOPIC 2: RESPIRATORY RATE, INHALE: EXHALE RATIO</b></p> <p><b>DEFINE the problem</b></p> <ul style="list-style-type: none"> <li>- What investigations are relevant in saving a life during COVID-19 Pandemic?</li> </ul>		






Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
<p>14.3 Biomedical innovation</p> <p>- scope and nature of biomedicine</p>			<p><b>Introduction:</b></p> <p><b>Watch:</b></p> <p><a href="#">COVID-19 – Information from the Department of Health</a></p> <ul style="list-style-type: none"> <li>- Why do we need ventilators?</li> <li>- How many more nurses and beds were needed to manage the pandemic in Australia? Therefore, how many more ventilators?</li> <li>- Why is importing ventilators challenging?</li> <li>- What technologies were used to assist production of ventilators?</li> <li>- What are the complications that come from COVID-19? What is happening inside the lungs during COVID-19?</li> <li>- What are the current measures taken to assist patients who are affected by COVID-19?</li> <li>- How does a respiratory system help?</li> <li>- What topics were thought of to investigate further to build knowledge?</li> <li>-</li> </ul> <p><b>Backstory:</b></p> <p>“You need to do some basic investigations into the lungs and different breathing patterns in order to help you design the ventilator, and program it to deliver the right breaths to a patient.</p> <p>Context is extremely important for engineering, and your supervisors wants to make sure you know everything you can before you start to design a solution. You will need to research the effect if COVID-19 on the lungs, and what current measures are being taken by doctors to help treat patients.</p>		




Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
			<p>Now that you know what kinds of things you want to investigate (breaths per minute, inspiratory/expiratory ratio (inhale : exhale ratio)), and why this is helpful to your design process, your supervisors wants you to design these investigations and perform them, with the help of your coworkers.”</p> <p><b>THINK</b></p> <p><b>Watch:</b>  <b>Ampcontrol Video 3: <a href="#">Mikhaila Halford Learning and Development Specialist</a></b></p> <ul style="list-style-type: none"> <li>- After hearing from Mikhaila, how did a range of experience assist the Ventilation project?</li> <li>- What career pathways or opportunities are there in the industry and why are they important?</li> <li>- What is inhale : exhale ratio?</li> <li>- Why is this ratio important to understand throughout the designing process?</li> </ul>		
14.5 Designing solutions to biomedical problems	- Apply an appropriate design process to design solutions to identified problems related to biomedicine		<p><b>CONSTRAINTS</b></p> <p>Discuss as a class and outline the constraints for the task</p> <ul style="list-style-type: none"> <li>- Generate the limitations of testing and the boundaries that need to be considered</li> <li>- Understanding of lung volume and inhale: exhale ratio</li> </ul> <p>Materials provided:</p> <ul style="list-style-type: none"> <li>- Stopwatch</li> </ul>		





Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- investigating</li> <li>- communicating</li> <li>- managing projects</li> </ul>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Design investigations that allow valid and reliable data and information to be collected</li> <li>- Use appropriate technologies and strategies for data collection or gathering information</li> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> </ul>		<p><b>BRAINSTORM</b></p> <p><b>Watch:</b></p> <p><a href="#">Amcontrol Video 4: Michael Cotton – Electronics technician</a></p> <ul style="list-style-type: none"> <li>○ How was Michael's role important and what was the brief when designing the ventilator?</li> <li>○ What issues occurred during the project?</li> <li>○ What could have assisted the process when creating the project?</li> <li>○ What technologies were used to create designs?</li> </ul> <ul style="list-style-type: none"> <li>- How can lung volume from previous experiments be useful?</li> <li>- How long does it take to deliver this volume (inhale)?</li> <li>- How long does it take to empty back out (exhale)? (inhale : exhale ratio)</li> <li>- How many times should this be delivered in a minute? (breaths per minute)</li> <li>- What are the current measures taken to assist patients with COVID-19?</li> <li>- What are the complications that come from COVID-19? How does it affect the lungs?</li> <li>- What is normal breathing?</li> <li>- What is a respiration rate?</li> <li>- How do you measure the respiratory rate?</li> <li>- What are the variables that can affect this rate?</li> </ul>		




Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
			<ul style="list-style-type: none"> <li>- Is respiratory rate at rest or when active more relevant in a clinical ventilator setting?</li> <li>- How to determine the average respiratory rate per minute?</li> <li>- How testing will be completed for active respiratory rate?</li> <li>- What is a reliable source to compare data?</li> <li>- How is this determined?</li> <li>- Effect of oxygen on the brain</li> <li>- How can breathing be brought back to normal quickly?</li> <li>- What is inspiratory : expiratory ratio?</li> <li>- How is this different to respiratory rate?</li> <li>- How do you measure inspiratory-expiratory ratio?</li> </ul>		
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- Designing</li> <li>- Researching</li> <li>- investigating</li> <li>- communicating</li> <li>- managing projects</li> </ul>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Design investigations that allow valid and reliable data and information to be collected</li> <li>- Use appropriate technologies and strategies for data collection or gathering information</li> <li>- Collect, analyse and apply the results of research and investigation</li> <li>- Produce solutions to problems related to biomedical</li> </ul>		<p><b>RESEARCH AND PLAN</b></p> <ul style="list-style-type: none"> <li>- Plan a scientific experiment to measure inhale : exhale ratio using points from the brainstorming session</li> <li>- Why is the average respiration rate relevant?</li> <li>- Plan how to find the average breath rate amongst a group of people</li> <li>- Discuss and plan for the variables that need to be considered</li> <li>- When would an active rate be useful?</li> </ul>		




Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
	<ul style="list-style-type: none"> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> </ul>				
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- Designing</li> <li>- managing projects</li> </ul> <p>14.5 Designing solutions to biomedical problems</p>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Apply an appropriate design process to design solutions to identified problems related to biomedicine</li> </ul>		<p><b>DEVELOP AND MAKE</b></p> <ul style="list-style-type: none"> <li>- Conduct scientific experiment and record data</li> <li>- Create a graph measuring breaths per minute</li> <li>- Prepare a formula to find the average of the results; individuals / group</li> </ul> <p><a href="#">DEMONSTRATION Video: Breaths per minute and Inhale: Exhale ratio</a></p>		
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- investigating</li> <li>- managing projects</li> <li>- evaluating</li> </ul>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> <li>- Evaluate processes and solutions to biomedical problems</li> </ul>		<p><b>TEST AND IMPROVE</b></p> <p><b>Static testing</b></p> <ul style="list-style-type: none"> <li>- One student breathes while another student times</li> <li>- To calculate breaths per minute: count the number of breathes in 15 seconds x 4</li> <li>- To find inhale: exhale ratio, use the 'lap' feature on the stopwatch to time the inhale and exhale times for a couple of breaths</li> <li>- Find the average of the 'lap' times and find the ratio</li> </ul> <p><b>After exercise</b></p> <ul style="list-style-type: none"> <li>- Complete the same tests after exercise</li> <li>- Collect data</li> </ul>		





Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- communicating</li> <li>- evaluating</li> </ul> <p>14.4 Analysis:</p> <ul style="list-style-type: none"> <li>- Statistics</li> </ul> <p>Using data to develop evidence-based arguments and conclusions</p>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> <li>- Evaluate processes and solutions to biomedical problems</li> <li>- Use mathematical, scientific and/ or graphical method as to solve biomedical related problems</li> <li>- Analyse data using statistical methods to develop evidence-based arguments and conclusions for biomedical based problems</li> </ul> <p>Undertakes investigation to collect valid and reliable data and information, individually and collaboratively</p>		<p><b>EVALUATE AND SHARE</b></p> <ul style="list-style-type: none"> <li>- Why is this testing relevant?</li> <li>- Who is this information useful to in the development of the respiratory system?</li> <li>- What were the limitations?</li> <li>- Justify why data may vary from the experimentation?</li> <li>- What information might need to be investigated further?</li> <li>- Compare the data between groups and discuss variables</li> </ul> <p><b>TASK:</b> Complete work and findings in:</p> <p><b>STUDENT WORKBOOK &amp; FINAL BIOMEDICAL REPORT TEMPLATE</b></p> <ul style="list-style-type: none"> <li>- As a continuation within the final report, include the findings from the experimentation on: <ul style="list-style-type: none"> <li>o Breaths per minute</li> <li>o Inhale: Exhale ratio</li> <li>o Define what things are, include experiments you have conducted and findings as a result.</li> <li>o Design process and procedures</li> </ul> </li> </ul>		



Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- Designing</li> <li>- managing</li> <li>- projects</li> </ul> <p>14.2 Biotechnologies Range of technologies used in biotechnology</p> <p>14.5 Designing solutions to biomedical problems</p>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Describe a range of technologies used in developing biomedical solutions</li> <li>- Perform experiments using a range of technologies to solve biomedical related problems</li> <li>- Use appropriate technologies for collecting data including data loggers and sensors</li> <li>- Use technologies typically used in the biosciences</li> <li>- Assesses the impact of new technologies on biomedical engineering</li> <li>- Apply an appropriate design process to design solutions to identified problems related to biomedicine</li> </ul>		<p><b>EXTENSION WORK</b></p> <p><b>DEVELOP AND MAKE</b></p> <ul style="list-style-type: none"> <li>- Write a basis C code which will take user input and then calculate lung volume, inhale : exhale ratio and breaths per minute</li> </ul> <p>Include:</p> <ul style="list-style-type: none"> <li>- The code</li> <li>- Logic flowchart</li> <li>- Logic instructions</li> </ul> <p>Coding Program: <a href="http://www.onlinegdb.com">www.onlinegdb.com</a></p> <ul style="list-style-type: none"> <li>- Click the green run button to run the code</li> </ul> <p>Full instructions for coding with some explanations are in the 'C Coding for your PEMS' document and full code is in the 'STEM Coding' file.</p>		




Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
14.1 Biomedical Innovation - applying processes - investigating - managing projects - evaluating	- Use a process to develop solutions to biomedical related problems - Manage the development of a biomedical project - Effectively communicate solutions to problems - Evaluate processes and solutions to biomedical problems		<b>TEST AND IMPROVE</b> <ul style="list-style-type: none"> <li>- Test the code works</li> <li>- Improve where possible</li> <li>- Justify changes</li> </ul>		
14.1 Biomedical Innovation - applying processes - communicating - evaluating  14.4 Analysis: - Statistics Using data to develop evidence-based arguments and conclusions	- Use a process to develop solutions to biomedical related problems - Manage the development of a biomedical project - Effectively communicate solutions to problems - Evaluate processes and solutions to biomedical problems - Use mathematical, scientific and/ or graphical method as to solve biomedical related problems - Analyse data using statistical methods to develop evidence-based arguments and		<b>EVALUATE AND SHARE</b> <ul style="list-style-type: none"> <li>- Evaluate how this could assist during the production of the respiratory system</li> <li>- Share with your peers how the code works and will assist a respiratory system.</li> </ul> <b>TASK:</b> Complete work and findings in:  <b>STUDENT WORKBOOK &amp; FINAL BIOMEDICAL REPORT TEMPLATE</b> <ul style="list-style-type: none"> <li>- As a continuation within the final report, include the findings from the experimentation on:               <ul style="list-style-type: none"> <li>o Code</li> <li>o Logic flowchart and instructions</li> </ul> </li> </ul>		








Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
	conclusions for biomedical based problems - Undertakes investigation to collect valid and reliable data and information, individually and collaboratively				

Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
14.1 Biomedical Innovation - applying processes - investigating 14.3 Biomedical innovation - scope and nature of biomedicine	- Use a process to develop solutions to biomedical related problems - Develop and understanding of the scope and nature of the biomedical professions		<b>TOPIC 3: LUNG COMPLIANCE</b> <b>DEFINE the problem</b> <ul style="list-style-type: none"> <li>- Without technology could we accommodate individual lungs during a pandemic?</li> </ul> <b>Introduction:</b> <ul style="list-style-type: none"> <li>- What is lung compliance?</li> <li>- How do you test for / measure lung compliance?</li> <li>- What technologies could help with measuring lung compliance</li> </ul> <b>Backstory:</b> <p>“Every single person’s lungs are different. Not only does everyone have a different lung volume, everybody also has a different respiratory rate, both demonstrated by previous investigations. What causes this? What else differs between people’s lungs, and is there a difference between one individual’s two lungs? What is lung compliance?”</p>		




Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
			<p><b>Watch:</b></p> <p><a href="#">Ampcontrol Video 5: Thomas Steigler – Research Engineer</a></p> <ul style="list-style-type: none"> <li>- What types of engineering was involved within the ventilation system?</li> <li>- What was needed to be researched?</li> <li>- What were the biggest challenges?</li> </ul> <p><b>Watch:</b></p> <p><a href="#">Ampcontrol VIDEO 6: Ryan Boyle – Product Engineer</a></p> <ul style="list-style-type: none"> <li>- What Is an embedded system?</li> <li>- How did these systems help the Ventilation Project?</li> <li>- How did you plan the system?</li> <li>- How has Ryan and Ampcontrol assisted during the Pandemic?</li> </ul> <p><b>THINK</b></p> <p><b>Watch:</b></p> <p><a href="#">The Respiratory System: Lung Compliance – Transpulmonary Pressure</a></p> <ul style="list-style-type: none"> <li>- What can the lungs be described as?</li> <li>- What does lung compliance mean?</li> <li>- What does Transpulmonary Pressure mean?</li> <li>- What factors reduce lung compliance?</li> </ul>		
14.5 Designing solutions to biomedical problems	- Apply an appropriate design process to design solutions to identified problems related to biomedicine		<p><b>CONSTRAINTS</b></p> <p>Discuss as a class and outline the constraints for the task</p> <ul style="list-style-type: none"> <li>- Using only the materials provided, demonstrate lung compliance</li> </ul>		





Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
			Materials provided: <ul style="list-style-type: none"> <li>- Regular balloon</li> <li>- Water balloon</li> <li>- Thick straw</li> <li>- Thin straw</li> </ul>		
14.1 Biomedical Innovation <ul style="list-style-type: none"> <li>- applying processes</li> <li>- investigating</li> <li>- communicating</li> <li>- managing projects</li> </ul>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Design investigations that allow valid and reliable data and information to be collected</li> <li>- Use appropriate technologies and strategies for data collection or gathering information</li> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> </ul>		<b>BRAINSTORM</b> <ul style="list-style-type: none"> <li>- How do we know that lung compliance exists?</li> <li>- From the <i>Define and Think cog</i>, define the problem</li> <li>- What does lung compliance mean in the context of COVID-19?</li> <li>- What needs to be considered when designing a ventilator?</li> <li>- How can we demonstrate lung compliance?</li> <li>- Discuss the variables that can assist the collation of data / make the testing easier / harder to represent lung compliance in different people</li> <li>- Will there be a technology element to assist?</li> <li>- Brainstorm how lung compliance can be demonstrated using only the materials provided. Use discussion, drawings and develop a procedure.</li> </ul>		
14.1 Biomedical Innovation <ul style="list-style-type: none"> <li>- applying processes</li> <li>- Designing</li> <li>- Researching</li> </ul>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Design investigations that allow valid and reliable data and information to be collected</li> </ul>		<b>RESEARCH AND PLAN</b> <ul style="list-style-type: none"> <li>- Develop a procedure to demonstrate lung compliance</li> <li>- Research further lung compliance</li> <li>- Outline how the data will be collated to demonstrate how to improve lung compliance</li> </ul>		



Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
<ul style="list-style-type: none"> <li>- investigating</li> <li>- communicating</li> <li>- managing projects</li> </ul>	<ul style="list-style-type: none"> <li>- Use appropriate technologies and strategies for data collection or gathering information</li> <li>- Collect, analyse and apply the results of research and investigation</li> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> </ul>		<ul style="list-style-type: none"> <li>- What will the testing of lung compliance look like?</li> <li>- Plan the investigation for testing compliance</li> </ul>		
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- Designing</li> <li>- managing projects</li> </ul> <p>14.5 Designing solutions to biomedical problems</p>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Apply an appropriate design process to design solutions to identified problems related to biomedicine</li> </ul>		<p><b>DEVELOP AND MAKE</b></p> <ul style="list-style-type: none"> <li>- Conduct scientific experiment and record data</li> <li>- Create the practical components for the collation of data of simulated lung compliance</li> </ul>		




Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
14.1 Biomedical Innovation - applying processes - investigating - managing projects - evaluating	- Use a process to develop solutions to biomedical related problems - Manage the development of a biomedical project - Effectively communicate solutions to problems - Evaluate processes and solutions to biomedical problems		<b>TEST AND IMPROVE</b> <ul style="list-style-type: none"> <li>- Create the practical components for the collation of data of simulated lung compliance</li> <li>- Complete a variety of tests using the difference materials provided</li> <li>- Record, graph and analyse data</li> <li>- Improve on these findings by making variables to testing</li> </ul>		
14.1 Biomedical Innovation - applying processes - communicating - evaluating  14.4 Analysis: - Statistics Using data to develop evidence-based arguments and conclusions	- Use a process to develop solutions to biomedical related problems - Manage the development of a biomedical project - Effectively communicate solutions to problems - Evaluate processes and solutions to biomedical problems - Use mathematical, scientific and/ or graphical method as to solve biomedical related problems - Analyse data using statistical methods to develop evidence-based arguments and		<b>EVALUATE AND SHARE</b> <ul style="list-style-type: none"> <li>- Evaluate your design</li> <li>- What did the testing demonstrate?</li> <li>- What improvements could be made to improve lung compliance?</li> <li>- Share your data with other groups – what were the differences between the groups?</li> <li>- Were there a variety of variables to consider?</li> <li>- Is there a better way to demonstrate lung compliance?</li> <li>- Why is this testing relevant?</li> <li>- Who is this information useful to in the development of the respiratory system?</li> <li>- What were the limitations</li> <li>- Justify why data may vary from the experimentation</li> <li>- Compare the data between groups and discuss variables</li> </ul> <b>TASK:</b>		




Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
	<p>conclusions for biomedical based problem</p> <ul style="list-style-type: none"> <li>- Undertakes investigation to collect valid and reliable data and information, individually and collaboratively</li> </ul>		<p>Complete work and findings in:</p> <p><b>STUDENT WORKBOOK &amp; FINAL BIOMEDICAL REPORT TEMPLATE</b></p> <ul style="list-style-type: none"> <li>- As a continuation within the final report, include the findings from the experimentation on:               <ul style="list-style-type: none"> <li>o What is lung compliance</li> <li>o How this investigation is important to the research and design of a ventilation system</li> <li>o What are the implications of compliance are there on an ventilation system</li> <li>o How can you demonstrate lung compliance – ensure to include sketches of design with annotations and photos of the experimentation and testing</li> <li>o Also include graphs and data to support your justification</li> </ul> </li> </ul>		




Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- investigating</li> </ul> <p>14.2 Biotechnologies</p> <p>Range of technologies used in biotechnology</p> <p>14.3 Biomedical innovation</p> <ul style="list-style-type: none"> <li>- scope and nature of biomedicine</li> </ul>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Describe a range of technologies used in developing biomedical solutions</li> <li>- Perform experiments using a range of technologies to solve biomedical related problems</li> <li>- Use appropriate technologies for collecting data including data loggers and sensors</li> <li>- Use technologies typically used in the biosciences</li> <li>- Assesses the impact of new technologies on biomedical engineering</li> <li>- Develop and understanding of the scope and nature of the biomedical professions</li> </ul>		<p><b>TOPIC 4: BUILDING A VENTILATION SYSTEM</b></p> <p><b>DEFINE the problem</b></p> <p><b>Backstory:</b></p> <ul style="list-style-type: none"> <li>- You are an engineer at Ampcontrol, employed to assist in creating a ventilation system. With the information that has been learn in the last 3 topics, design a system that simulates ventilation and air flow that could assist a person who has contracted COVID-19</li> </ul> <p><b>Watch:</b></p> <p><a href="#">Ampcontrol VIDEO 7: Ian Webster – Group Engineering Manager</a></p> <ul style="list-style-type: none"> <li>- What does an engineering manager do and how did Ian contribute to the ventilator project?</li> <li>- How was the work organised? Create a flow chart of the work flow /system streams.</li> <li>- What were the constraints and issues that Ampcontrol faced?</li> <li>- Why is teamwork important?</li> </ul> <p><b>Watch:</b></p> <p><a href="#">Ampcontrol VIDEO 8: Aaron Breese – Senior control and systems engineer</a></p> <ul style="list-style-type: none"> <li>- What role did Aaron play within the ventilation project?</li> <li>- What processes were taken to plan and deliver?</li> <li>- What experiences have assisted Aaron’s understanding towards his current role?</li> </ul> <p><b>THINK</b></p>		





Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
			<p>In groups students are to design a simulated respiratory system</p> <p>Define your task and discuss the constraints. You need to make a pump, why will that be hard? Consider the following points:</p> <ul style="list-style-type: none"> <li>• What skills do you have within your group and how can you effectively contribute to the creation of the ventilator?</li> <li>• What materials do you have available? Could you use a bike pump if all else fails? Do not forget the first video you watched about how Ampcontrol overcame their drawbacks.</li> </ul>		
14.5 Designing solutions to biomedical problems	- Apply an appropriate design process to design solutions to identified problems related to biomedicine		<p><b>CONSTRAINTS</b></p> <p>Discuss as a class and outline the constraints for the task</p> <ul style="list-style-type: none"> <li>- Roles and responsibilities of each group member</li> <li>- Where are there deficits in skills/knowledge to create and system?</li> <li>- Materials and technology available</li> <li>- Time to create an effective system</li> </ul> <p>Materials provided:</p> <ul style="list-style-type: none"> <li>○ 3D printed parts</li> <li>○ Base</li> <li>○ Cone</li> <li>○ Y-Piece</li> <li>- 2 x thin plastic fruit bags</li> <li>- Cardboard/ Plastic chopping mat</li> <li>- <a href="#">DC Motor</a></li> </ul>		







Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
			<ul style="list-style-type: none"> <li>- <a href="#">Fan blade attachment</a></li> <li>- <a href="#">Battery holder</a> and batteries</li> </ul> <p>**If you do not have access to a 3D printer, the parts can easily be made out of rolled up paper for the Y-Piece and Cone, and the Base can be made out of cardboard or the plastic chopping mat.</p>		
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- investigating</li> <li>- communicating</li> <li>- managing projects</li> </ul>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Design investigations that allow valid and reliable data and information to be collected</li> <li>- Use appropriate technologies and strategies for data collection or gathering information</li> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> </ul>		<p><b>BRAINSTORM</b></p> <p><b>WATCH:</b> <a href="#">How do Ventilators work? – Alex Gendler</a></p> <ul style="list-style-type: none"> <li>- Brainstorm what areas / topics that need to be investigated more before designing can take place</li> <li>- Will the system involve technology or automation?</li> <li>- Is the system an open / closed?</li> <li>- What materials / products will be needed to create the system</li> <li>- Representation of the practice</li> <li>- Materials to use to create a prototype</li> <li>- Role and responsibilities of the group members</li> <li>- Timing for practical and presentation elements to be completed</li> <li>- Technology / platform to deliver the presentation</li> <li>- What information do you already have, how can this be used?</li> <li>- Will you use any technology or automation?</li> <li>- Are there any extra materials you might need? Any extra parts?</li> <li>- How might you create pressure to fill the lungs?</li> </ul>		

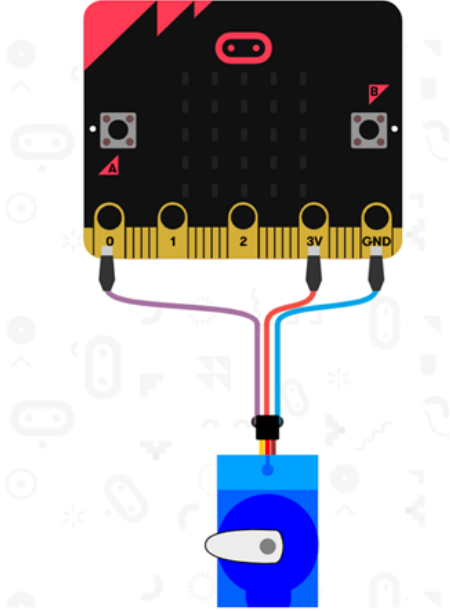


Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
14.1 Biomedical Innovation - applying processes - Designing - Researching - investigating - communicating - managing projects	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Design investigations that allow valid and reliable data and information to be collected</li> <li>- Use appropriate technologies and strategies for data collection or gathering information</li> <li>- Collect, analyse and apply the results of research and investigation</li> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> </ul>		<b>RESEARCH AND PLAN</b> <ul style="list-style-type: none"> <li>- Research Brainstormed topics</li> <li>- Research and plan ideas of creating simulation ventilation system</li> <li>- Draw concept ideas for possible solutions</li> <li>- Collect materials which can simulate the respiratory system</li> </ul>		
14.1 Biomedical Innovation - applying processes - Designing - managing projects 14.5 Designing solutions to biomedical problems	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Apply an appropriate design process to design solutions to</li> </ul>		<b>DEVELOP AND MAKE</b>  <b>Task:</b> Utilising research and knowledge acquired from this unit, build a ventilator 'pump' system using the equipment above.  <b>WATCH:</b> <a href="#">Amcontrol Video DEMONSTRATION: Pump Assembly</a>		

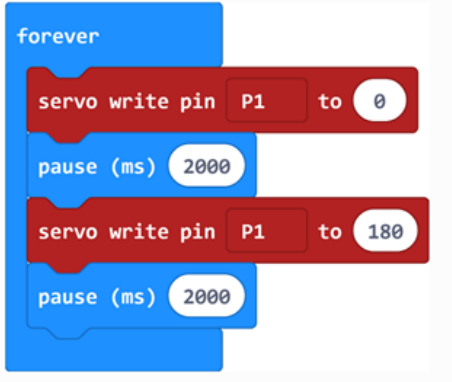



Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
	identified problems related to biomedicine		<ul style="list-style-type: none"> <li>- Develop and make a basic assembly of the Pump</li> </ul>		
14.1 Biomedical Innovation - applying processes - investigating - managing projects - evaluating	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> <li>- Evaluate processes and solutions to biomedical problems</li> </ul>		<p><b>TEST AND IMPROVE</b></p> <ul style="list-style-type: none"> <li>- Test and see what works</li> <li>- Make reiterations of your design and improve what you can</li> <li>- Create some test lungs</li> <li>- Using plastic freezer bags and cardboard, and hook everything up</li> <li>- Use your pump to inflate the lungs to simulate an inhale, and then let the air flow out to simulate the exhale</li> <li>- Are there elements within the constraints that are too restrictive?</li> </ul> <p><b>TASK:</b></p> <ul style="list-style-type: none"> <li>- Identify and improve ONE improvement</li> <li>- Draw and annotate why this would be an improvement on the pump</li> </ul>		
14.1 Biomedical Innovation - applying processes - Designing - managing projects 14.2 Biotechnologies Range of technologies used in biotechnology	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Produce solutions to problems related to biomedical</li> <li>- Manage the development of a biomedical project</li> <li>- Describe a range of technologies used in developing biomedical solutions</li> </ul>		<p><b>EXTENSION WORK</b></p> <p><b>DEVELOP AND MAKE</b></p> <p><b>Micro:bit</b></p> <ul style="list-style-type: none"> <li>- Coding Program: <a href="http://www.microbit.org">www.microbit.org</a></li> <li>- Use a micro:bit controller to turn the pump on and off to match the breaths per minute and inhale: exhale ratio that you found. Connect the micro:bit to your servo motor as follows:  <b>*please note; 'Ground wire' – shown in blue, however in Australia is typically black.</b></li> </ul>		




Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
14.5 Designing solutions to biomedical problems	<ul style="list-style-type: none"> <li>- Perform experiments using a range of technologies to solve biomedical related problems</li> <li>- Use appropriate technologies for collecting data including data loggers and sensors</li> <li>- Use technologies typically used in the biosciences</li> <li>- Assesses the impact of new technologies on biomedical engineering</li> <li>- Apply an appropriate design process to design solutions to identified problems related to biomedicine</li> </ul>		<p>The system can also be run without the 'Purple wire running to 0'.</p>  <p>Using a micro:bit and the <a href="http://microbit.org">microbit.org</a> website, two tasks can be completed;</p> <p><b>Example 1:</b></p> <pre>input.onButtonPressed(Button.A, function () {   pins.servoWritePin(AnalogPin.P0, 180)   basic.pause(1000) })</pre>		



Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
			<pre>input.onButtonPressed(Button.B, function () {   pins.servoWritePin(AnalogPin.P0, 0)   basic.pause(1000) })</pre> <p><b>Example 2:</b></p> 		
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- investigating</li> <li>- managing projects</li> <li>- evaluating</li> </ul>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> <li>- Evaluate processes and solutions to biomedical problems</li> </ul>		<p><b>TEST AND IMPROVE</b></p> <p><b>Example 1 discussion question:</b></p> <ul style="list-style-type: none"> <li>- Does the code work?</li> <li>- How could you use this code to simulate inhale : exhale ratio?</li> <li>- How can this model be improved?</li> </ul> <p><b>Example 2 discussion questions:</b></p> <ul style="list-style-type: none"> <li>- Does the code work?</li> <li>- Discuss what each block code means?</li> </ul>		-



Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
			<ul style="list-style-type: none"> <li>- What changes would you make to the block coding to simulate your calculated inhale : exhale ratio?</li> <li>- Can this code be improved further?</li> </ul>		
<p>14.1 Biomedical Innovation</p> <ul style="list-style-type: none"> <li>- applying processes</li> <li>- communicating</li> <li>- evaluating</li> </ul> <p>14.4 Analysis:</p> <ul style="list-style-type: none"> <li>- Statistics</li> </ul> <p>Using data to develop evidence-based arguments and conclusions</p>	<ul style="list-style-type: none"> <li>- Use a process to develop solutions to biomedical related problems</li> <li>- Manage the development of a biomedical project</li> <li>- Effectively communicate solutions to problems</li> <li>- Evaluate processes and solutions to biomedical problems</li> <li>- Use mathematical, scientific and/ or graphical method as to solve biomedical related problems</li> <li>- Analyse data using statistical methods to develop evidence-based arguments and conclusions for biomedical based problem</li> <li>- Undertakes investigation to collect valid and reliable data and information, individually and collaboratively</li> </ul>		<p><b>EVALUATE AND SHARE</b></p> <p><b>Task:</b></p> <p>Complete work and findings in:</p> <p><b>STUDENT WORKBOOK &amp; FINAL BIOMEDICAL REPORT TEMPLATE</b></p> <ul style="list-style-type: none"> <li>- Justify your pump design and include this in your final report</li> <li>- Outline and discuss the ventilator design throughout the testing phase</li> <li>- Consider and address the challenges which were managed during the process</li> <li>- Justify choices for the final solution and explain their benefits</li> <li>- Write a results paragraph, and include an evaluation</li> <li>- Include photos and annotations of the process you have taken</li> </ul> <p><a href="#">Ampcontrol Video: And that is a wrap</a></p>		



Students learn to:	Students learn about:	STEM Process	Content/ Teaching and Learning Sequence	Evidence of Learning	Registration
Additional Teacher Resources (Further Research for Teachers)			Teacher and Student Evaluation		

