

# Carbon Capture

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This resource was developed as a result of participation in CSIRO's teacher professional learning program, Teacher Researcher in Partnership Program.

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This Ferny Grove State High School Unit is based on Earth & Space

<b>Title: Catch that Carbon</b>	<b>Duration: 2 weeks</b>
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## Teaching and Learning Sequence and Related Resources

Week 1 – 3 Lessons	
<p><b>L1 :</b>  <b>Title: Pre-knowledge test &amp; Misconceptions</b>  <b>Learning Intentions</b>  <b>KNOWLEDGE</b> – students will learn about:            Inquiry: Climate change and greenhouse gasses  <b>SKILL</b> – students will learn to:            Understand the basics of the enhanced greenhouse effect and key gases involved</p> <p><b>L2:</b>  <b>Title: Carbon capture - what is it?</b>  <b>Learning Intentions</b>  <b>KNOWLEDGE</b> – students will learn about:            CSIRO current Carbon &amp; Methane capture technology</p> <p><b>SKILL</b> – students will learn to:            Analyse a <b>short text</b> based on current CSIRO carbon capture technology            Build vocabulary            Work in pairs to discuss advantages &amp; disadvantages            Analyse using a PMI chart            Numeracy calculating</p>	<p><b>Additional Resources:</b> Pre-test what do students know about climate change?  <a href="https://www.abc.net.au/science/games/quizzes/2009/climatechange/">https://www.abc.net.au/science/games/quizzes/2009/climatechange/</a></p> <p>Teacher to <b>show pictures and powerpoint</b> about lab experience</p> <p><b>Websites: Video explaining carbon capture &amp; storage</b>  <a href="https://www.youtube.com/watch?v=ROEFaHKVmSs">https://www.youtube.com/watch?v=ROEFaHKVmSs</a>  <a href="https://breakingnewsenglish.com/1806/180611-carbon-capture.html">https://breakingnewsenglish.com/1806/180611-carbon-capture.html</a></p> <p><b>Supporting learning resources:</b>  <b>ENVIRONMENT:</b> Spend one minute writing down all of the different words you associate with the word "environment". Share your words with your partner(s) and talk about them. Together, put the words into different categories.  <b>GLOBAL WARMING:</b> Rank these with your partner. Put the best ways to prevent global warming at the top. Change partners and share your rankings x 3.</p>

<p><b>L3:</b>  <b>Title: Carbon capture what else is out there?</b>  <b>Learning Intentions</b>  <b>KNOWLEDGE</b> – students will learn about:  carbon capture technology (biocells, storage, other technologies from other Research groups)</p> <p><b>SKILL</b> – students will learn to:  Research  Note taking  Evaluate resources</p>	<p>Use less hot water, Plant a tree, Eat less meat, Turn off lights, Drive less, Go solar, Recycle, Reduce waste  Use synonyms, gap fill and comprehension questions for text work &amp;  Write 5 good questions about carbon capture, exchange with a partner</p> <p><b>Evaluation matrix</b> for internet research</p>
<p><b>Weeks 2 3 Lessons</b></p>	
<p><b>L1&amp;L2 Title: Carbon capture symposium</b>  <b>Learning Intentions</b>  <b>KNOWLEDGE</b> – students will learn about:  Different ways of carbon capture</p> <p><b>SKILL</b> – students will learn to:  Present their findings to peers  Using ICT to arrange researched information in a digital presentation tool (glogster)  Assess peer presentations using a rubric</p> <p>L3: Formative extended writing response: Carbon capture will reverse climate change. Discuss (why, how, what) 1 Lesson in class 250-300 words</p> <p>□</p>	<p><b>Additional Resources:</b>  <b>Glogster teacher access or alternative online collaboration tool</b>  <b>Peer rubric</b></p> <p><b>Supporting learning resources:</b>  <b>Task sheet</b> formative assessment</p>

Curriculum Links:

Chemical change involves substances reacting to form new substances

[\(ACSSU225\)](#)

People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity

[\(ACSHE136\)](#)

Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate

[\(ACSI148\)](#)

## Carbon Capture by CSIRO

Growing concerns regarding climate change have attracted widespread efforts to develop efficient and cost-effective technologies for CO<sub>2</sub> capture from industrial sources such as coal-fired power plants to minimise CO<sub>2</sub> emissions and combat global warming.

CO<sub>2</sub> capture using porous solid sorbents (substances which have the property of collecting molecules of another substance by absorption or adsorption) appears to be a promising solution. Among them, porous carbon materials are particularly suited to CO<sub>2</sub> capture because of their microporosity (containing very narrow pores), ease of fabrication and excellent chemical, thermal and mechanical stability. Porous carbons have been produced since antiquity by charring coal and charcoal has been used for the purification of water and as a medicine.

However, achieving acceptable attachment rates of CO<sub>2</sub> from combustion exhaust gas streams of coal-fired power plants to the surface of the sorbent remains a challenge.

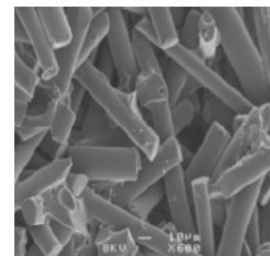
Approaches to improving CO<sub>2</sub> uptake of porous carbons have focused on chemical activation. These methods have disadvantages such as greater complexity and cost.

At CSIRO's Queensland Center for Advanced Technologies the research is focused on developing a simple and cost-effective way to fabricate physically activated carbon composite monoliths that contain honeycomb structures with superior CO<sub>2</sub> sorption properties. Studies in the Lab determine the pore size of the sorbent, CO<sub>2</sub> adsorption rates under different conditions (heat & pressure) as well as the time needed to capture the CO<sub>2</sub> from a gas stream.

Length: 80mm, Dia: 30mm, Number of Channels: 17,



Fabricated (HMCFC)



Microscopic morphology

### Activities:

a) *Vocabulary*: Match the correct meaning.

Word	meaning
widespread	The outside or upper layer of something
combustion	Catching or trapping something
capture	Action of manufacturing something
fabrication	The process of burning something
charring	A way of dealing with a situation
surface	Found or distributed over a large area
approaches ( <i>noun</i> )	The state of something
conditions	Partially burn so as to blacken the surface

b) *Synonyms*. Find a synonym for each of the following words.

Word	Synonym
thermal	
combat	
substance	
challenge	
superior	
promising	
rates	

c) *Comprehension*. Answer the following questions.

1. Where is the research taking place?
2. Where is the CO<sub>2</sub> captured from?
3. What is the process of CO<sub>2</sub> hoping to combat?
4. Since when have porous carbons been made?
5. What are the disadvantages of chemical activation?
6. What type of monoliths is CSIRO developing?



## YEAR 8 Science

Formative

<b>Student Name:</b>					
<b>Class:</b>		<b>Teacher:</b>			
<b>Unit 1</b>	<b>Draft Date:</b>	<b>N/A</b>	<b>Due Date:</b>	<b>Week Term</b>	
<b>CONTEXT</b>	Growing concerns about global warming and climate change have Scientists looking for new ways to combat these issues. One of the greenhouse gasses, Carbon dioxide, is at the center of attention due to the release of large quantities of this gas by burning fossil fuels. Reducing the emissions of CO <sub>2</sub> is one way to minimise the effects but new technologies are addressing CO <sub>2</sub> reduction in different ways.				
<b>Task</b>			<b>Text Type:</b>	Extended Response	
You have learnt about the technology of carbon capture. You are required to write an extended response to the statement “ Carbon capture will reverse climate change”.					
<b>Cognitive Verbs</b>	<ul style="list-style-type: none"> <li>Assess</li> <li>Compare</li> <li>Conduct</li> <li>Consider</li> </ul>	<ul style="list-style-type: none"> <li>Discuss</li> <li>Evaluate</li> <li>Apply</li> </ul>	<ul style="list-style-type: none"> <li>Express</li> <li>Justify</li> <li>Identify</li> <li>Determine</li> <li>Develop</li> </ul>	<ul style="list-style-type: none"> <li>Define</li> <li>Describe</li> </ul>	
<b>Vocab</b>	<ul style="list-style-type: none"> <li>Climate change</li> <li>Carbon dioxide</li> <li>Technology</li> <li>Absorption/adsorption</li> <li>storage</li> </ul>		<ul style="list-style-type: none"> <li>emissions</li> <li>greenhouse gas</li> <li>photosynthesis</li> <li>fossil fuel</li> <li>human-induced</li> </ul>		
<b>Conditions</b>					
<b>Audience:</b>	Classroom Teacher				
<b>Class working time:</b>	1 X 70 MIN CLASS				
<b>Length:</b>	Approximately 250-300 Words				
<b>Final Submission Requirements:</b>	All questions answered, correct spelling and punctuation				
<b>Materials allowed:</b>	Materials supplied in class + any supplied & negotiated with class teacher				
<b>Other:</b>	N/A				
<b>Student Acknowledgement:</b>			<b>Student Signature:</b>		
I acknowledge that this is my original work. If I have used research material, it has been correctly referenced. I give Ferry Grove SHS permission to use and reproduce my work for publication and promotion purposes. School policy regarding plagiarism and assessment is located in the student diary.					
			<b>Date:</b>		

## Helpful Hints

### Key Terms:

Compare: display recognition of similarities and differences and recognise the significance of these similarities and differences
Define: give the meaning of a word, phrase, concept or physical quantity; state meaning and identify or describe qualities.
Describe: give an account (written or spoken) of a situation, event, pattern or process, or of the characteristics or features of something.
Evaluate: make an appraisal by weighing up or assessing strengths, implications and limitations; make judgments about ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria.

### Sentence Starters:

There are several/ many reasons for...
The weight of evidence would suggest...
...this a better option than...
In the case of..., the following details have emerged...
The main difference between...
Clearly, it can be concluded that...
Upon examination it is seen that...

### Connecting ideas within and between sentences:

The reason for...	This is why...
However...	Therefore...
On the other hand...	Contributed to...
Thus...	Although...
In order for...	Hence...
As a result...	Because...

Answer all questions in full sentences with correct spelling and punctuation.

**Define** climate change and provide three examples of its impact. (25 words)

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**Compare** the difference between reducing carbon emissions and capturing carbon. (50 words)

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**Describe** a method of carbon capture. Include the science of the technology, who invented it and whether it is currently in use or in testing stages. (100 words)

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**Evaluate** the use of Carbon Capture technology on reducing the impact of climate change (100 words).

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Student name: \_\_\_\_\_ Year level: \_\_\_\_\_ Class: \_\_\_\_\_ Teacher: \_\_\_\_\_

Nature and development of science	<ul style="list-style-type: none"> <li>• <u>examination and justified explanation</u> of how different science knowledge is used in occupations</li> <li>• <u>justified</u> explanation of how evidence has led to an improved understanding of a scientific idea</li> </ul>	<ul style="list-style-type: none"> <li>• <u>examination and explanation</u> of how different science knowledge is used in occupations</li> <li>• <u>informed</u> explanation of how evidence has led to an improved understanding of a scientific idea</li> </ul>	<ul style="list-style-type: none"> <li>• examination of the different science knowledge used in occupations</li> <li>• explanation of how evidence has led to an improved understanding of a scientific idea</li> </ul>	<ul style="list-style-type: none"> <li>• <u>description</u> of science knowledge used in science occupations</li> <li>• <u>description</u> of how understanding of a scientific idea has changed</li> </ul>	<u>statements about</u> <ul style="list-style-type: none"> <li>• science used in occupations</li> <li>• scientific ideas</li> </ul>
Use and influence of science	<ul style="list-style-type: none"> <li>• <u>thorough</u> description of situations in which scientists collaborated to generate solutions to contemporary problems</li> <li>• <u>thorough</u> reflection on the implications of these solutions for different groups in society</li> </ul>	<ul style="list-style-type: none"> <li>• <u>informed</u> description of situations in which scientists collaborated to generate solutions to contemporary problems</li> <li>• <u>informed</u> reflection on the implications of these solutions for different groups in society</li> </ul>	<ul style="list-style-type: none"> <li>• description of situations in which scientists collaborated to generate solutions to contemporary problems</li> <li>• reflection on the implications of these solutions for different groups in society</li> </ul>	<ul style="list-style-type: none"> <li>• <u>identification</u> of situations where scientists generate solutions to contemporary problems</li> <li>• <u>identification</u> of implications of these solutions</li> </ul>	<u>statements about:</u> <ul style="list-style-type: none"> <li>• solutions to contemporary problems</li> <li>• implications of solutions</li> </ul>
Communicating	<u>concise and coherent</u> use of appropriate language and <u>accurate</u> representations to communicate science ideas, methods and findings in a range of text types	<u>coherent</u> use of appropriate language and <u>accurate</u> representations to communicate science ideas, methods and findings in a range of text types	use of appropriate language and representations to communicate science ideas, methods and findings in a range of text types	use of <u>everyday</u> language and representations to communicate science ideas, methods and findings	<u>fragmented</u> use of language and representations to communicate science ideas, methods and findings

Teacher feedback: \_\_\_\_\_

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