Faculty of Education

Assessment Task Cover Sheet

Unit Co-ord./Lecturer	Donna Satterthwait	**OFFICE USE ONLY** Assessment received:
Tutor:(if applicable)		
Student ID	078395	
Student Name	Emma Stubbs	
Unit Code	ESM702	
Unit Name	Science Education: Inquiry and Argumentation	
Assessment Task Title/Number	Assessment Task 2	

I declare that all material in this assessment task is my own work except where there is clear acknowledgement or reference to the work of others **and** I have complied and agreed to the University statement on Plagiarism and Academic Integrity on the University website at www.utas.edu.au/plagiarism *

Signed E.Stubbs Date 30/09/2016

*By submitting this assessment task and cover sheet electronically, in whatever form, you are deemed to have made the declaration set out above.

Assessor's feedback:

Assessor: ***Donna Satterthwait***

This three week lesson sequence takes place within a year nine science classroom. This sequence is aimed at students developing their scientific inquiry and argumentation skills and focuses on the main curriculum content descriptor of *Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)* (Australian Curriculum Assessment and Reporting Authority [ACARA], 2015, P.17). The learning outcome for this sequence is for the students to develop and conduct their own scientific inquiry and to use the data collected to form an argument to be presented to a mock council.

The lesson sequence focuses on developing science inquiry skills through the investigation of the health of systems, mainly freshwater streams. Over the course of this sequence students begin by developing their scientific vocabulary and refreshing prior knowledge on ecosystems. The students are then asked to investigate how scientific research can argue, by the selection of key indicators, the health of a system. With this knowledge of key indicators, students are required to develop an experimental design in order to test the health of an ecosystem against a control and to compare to another selected site. The sequence then culminates in students developing an argument, based on data collected and analysed from their inquiry. Students are to complete a presentation based around the key question 'Is this area healthy?' using their own data as evidence to support their argument. This lesson sequence includes constant and ongoing formative assessment, to ensure student understanding and to improve teaching practices. This sequence ends with a group presentation of an argument based on evidence which forms the students' summative assessment piece. This will be assessed against a marking rubric (Appendix 2) which also assesses the students audience behaviour encouraging behaviour appropriate to the scientific community they are portraying.

This lesson sequence is designed to allow students to develop their own understanding and scientific skills and focuses on constructive alignment. Constructive alignment is where students achieve the desired learning outcomes and create their own

meaning through hands on learning activities (Biggs, 1996). Constructive alignment also aims to strengthen a student's understanding of a topic by introducing new concepts and linking to previously learnt concepts and constantly building the student's understanding (Biggs, 1996).

The use of inquiry and argumentation within the science classroom has become more common over the past 10 years. Argumentation is defined as logical discourse whose goal is to tease out the relationship between ideas and the evidence (Grooms, Enderle & Sampson, 2015). Recent studies have found that students develop deeper conceptual understanding of scientific concepts through the use of argumentation within the science classes (Osborne, 2010). One of the main learning outcomes for the science curriculum is to encourage and develop scientific thinking and reasoning within students (Australian Curriculum Assessment and Reporting Authority [ACARA], 2015, P.4). Therefore this lesson sequence also has a strong focus on Science as a Human Endeavour; *People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people's lives, including generating new career opportunities (ACSHE160)* (Australian Curriculum Assessment and Reporting Authority [ACARA], 2015, P.15).

Inquiry and argumentation is strongly aligned with this learning outcome as inquiry based sequences encourage students to 'think like a scientist' and to form an argument based on data. While students are learning content through inquiry, they are, more importantly, developing scientific reasoning and inquiring skills that are also important life skills (Sampson, Grooms & Walker, 2011). Inquiry based sequences have been shown to improve conceptual understanding and expose students to scientific discourse (Osborne, 2010). This type of inquiry and argumentation sequence allows students to view and be part of a mock scientific study and to understand how scientific opinions are generated by the collection and analysis of data. This is a life skill and will allow students to understand real-life scientific inquiries and assess for themselves the validity of an argument based on evidence (Sampson, Grooms & Walker, 2011).

	Topic	Learning Activity	Resources	Learning Outcomes
Lesson 1	Introduction to Water Systems	Assessing prior knowledge through discussion and developing a vocabulary guide.	You-tube video. Science textbooks, library access and internet access. Science inquiry exercise book.	Refreshing ecosystem knowledge and to become familiar with scientific language relating to ecosystems.
Lesson 2	What makes a system healthy?	Developing argumentation skills via whole class discussion about what is 'healthy'? Pairs to discuss and report back to the class using scientific vocabulary	Pictures of two Ecosystems (Appendix 1)	Students to form an argument as to whether an ecosystem is healthy based on evidence of observable characteristics.
Lesson 3	Research Key Indicators	In pairs students research other scientific ways in which to assess the 'health' of an ecosystem and present findings to the class as a mini presentation.	Students require library and internet access to complete research task into key scientific indicators. Smart-Board.	To build on concepts developed in lesson two, Students are to build their own ideas of what could be used to indicate the 'health' of an ecosystem.
Lesson 4	Class Discussion on Key Indicators	Student lead discussion on which key indicators would best assess the health of the original two pictures and come to a consensus of what indicators will be used.		Students will reflect on their own choice of concepts and determine if they are scientific and relevant to the inquiry.
Lesson 5	Develop Experimental Design	Development of an experimental design.	Science inquiry exercise book to record the experimental design.	Students will use knowledge of scientific indicators developed to create an experimental inquiry design to test the health of an ecosystem.
Lesson 6	Data Collection - Control	Collection of data from control site – testing experimental design.	Transport to control site and sites 1 and 2, science inquiry exercise book containing approved design. Ecosystem and water testing and equipment based on key	Students will gain a sound knowledge of scientific methods to collect data from an ecosystem based on the experimental design. Students will learn how to use the equipment and how to ensure validity of the data.
Lesson 7	Data Collection – Site One	Collection of data from site one		
Lesson 8	Data Collection – Site Two	Collection of data from site two		

			indicators selected by students.	
Lesson 9	Data Analysis	Analysis of data collected at the two sites and the control site.	Access to a computer lab with Microsoft Excel for analysis.	Students are to compare and contrast the different sites and the control site to develop a picture of the health of the ecosystem. Building on the data analysis from the previous lesson, students are to use their own investigation to develop a position on the health of a system and use the evidence collected to develop an argument.
Lesson 10	Develop Argument	In pairs, students to develop a presentation to a 'mock' council to critically argue whether the systems tested are healthy. To be presented the following two lessons.		
Lesson 11	Group Presentations	Students to present their scientific argument to the mock council panel. When not presenting students are to act as members of the community commenting and questioning the presentations.	Marking Rubric (Appendix 2)	Students to act in a scientific way to present an argument based on the collection and analysis of data. Students are also required to participate in the scientific discourse of presenting in a 'real-world' situation and answering questions from the community.
Lesson 12				

<table>
<tr><td colspan="2">Learning area: Inquiry and Argumentation – Lesson 1</td><td>Date: 20/09/2016</td></tr>
<tr><td colspan="2">Topic: Health of Ecosystems
Key question: What is an Ecosystem?</td><td>OH & S
Basic Science Lab Safety rules</td></tr>
<tr><td colspan="3">Learning objectives:
By the end of the lesson students will have a refreshed knowledge of what an ecosystem is and a sound understanding of the scientific vocabulary used to describe an ecosystem.</td></tr>
<tr><td colspan="2">Anticipatory set:
Draw on students' prior knowledge by asking key questions:
What is an ecosystem?
How would you describe an ecosystem?</td><td rowspan="6">Checking for understanding & feedback
Teacher to tour the classroom while pairs are discussing their definitions
Questioning pairs as to why they have decided on this definition, prompting the students to think about why they think this is the best scientific definition and what characteristics they have felt important as descriptors.
Checking on glossaries of scientific terms while moving around the room
Write up the 'what the scientist says' definition and draw the class back together
Outline the independent practice needed to be completed by the following lesson.</td></tr>
<tr><td colspan="2">Communicating learning objectives: Today we will be learning about ecosystems and developing our scientific vocabulary about ecosystems.</td></tr>
<tr><td colspan="2">Input, modelling & learning activities:
Students are to watch a You-tube video, recording scientific terms used in relation to ecosystems
Students are then to summarise the video and come up with a scientific definition of an ecosystem.
Think, Pair, Share activity: Students are then to pair up and share their definition, providing reasons behind their definition and addressing any differences with their partner. After discussion over the two definitions the pairs are to create one definition and write it into their Science inquiry exercise book.
In their pairs, students are to combine their list of scientific terms from the video and work together to create a vocabulary guide in their exercise books.</td></tr>
<tr><td colspan="2">Guided practice:
The teacher is to begin this class by posing the anticipatory set of questions for the students to reflect on their own prior knowledge before watching the video. Teacher is to instruct the students to make a list of all scientific terms relating to ecosystems mentioned within the video.
The teacher then explains the think, pair, share activity and allows the students to begin the learning activities. Nearing the end of the lesson the teacher writes up the scientific definition on the board. The students are to copy this down and compare with their own definition.</td></tr>
<tr><td colspan="2">Conclusion:
Draw the class back together for a discussion and to reinforce the learning outcome. Students are to consider how much of their prior knowledge had come back to them and to reflect on the differences between the pairs' definition and now the 'scientists' definition.</td></tr>
<tr><td colspan="2">Independent practice:
Students are to reflect on their pairs' definition in comparison to the 'scientists' definition. Students are to write two sentences on how the two are different and how they are similar to be handed to the teacher next lesson.</td></tr>
</table>

<table>
<tr><td colspan="2">Learning area: Inquiry and Argumentation - Lesson 2</td><td>Date: 22/09/2016</td></tr>
<tr><td colspan="2">Topic: Health of Ecosystems and water sources
Key question: What makes an Ecosystem healthy?</td><td>OH & S
Basic Science Lab Safety rules</td></tr>
<tr><td colspan="3">Learning objectives:
By the end of the lesson students will have an understanding of how to form an argument based on observable features. Students will also be encouraged to use and become familiar with the scientific terms developed in their glossary from the previous lesson.</td></tr>
<tr><td colspan="2">Anticipatory set:
Draw on students' prior knowledge by asking key questions:
What is an ecosystem? How did you describe it?
What does it look like?
Can we have healthy and unhealthy systems?</td><td rowspan="6">Checking for understanding & feedback
Teacher to tour the classroom while pairs are discussing the two ecosystems and how they fit with their definitions
Questioning pairs as to what features they are using to assess health?
Asking the students to think about whether there are other ways, if we were there, to decide if it is healthy.
While moving around the room write up the argumentation definition and draw the class back together
Outline the independent practice thinking activity needed to be completed by the following lesson.</td></tr>
<tr><td colspan="2">Communicating learning objectives: Today we will be further developing our understanding of ecosystems and developing our scientific argumentation skills.</td></tr>
<tr><td colspan="2">Input, modelling & learning activities:
Students are to get back into their pairs and are given two pictures of ecosystems.
Students are to discuss in their pairs how these two pictures fit with their own definition developed last lesson and the scientific definition of an Ecosystem.
Students are then to copy down the scientific definition of argumentation from the board.
They are then required to come up with an argument based on observable evidence (key indicators) as to whether each of these ecosystems are healthy.
Pairs are to combine creating groups of four and then to explain their argument, supported by evidence and listen to other arguments</td></tr>
<tr><td colspan="2">Guided practice:
Teacher to begin the class by refreshing achieved learning outcomes from the previous lesson, and to hand out the two pictures to each pair. As pairs are discussing how these two pictures fit with their definition, teacher is to write up a information on argumentation on the board and gradually to guide students into using this information to form an argument position.</td></tr>
<tr><td colspan="2">Conclusion:
Draw the class back together for a discussion and ask students to briefly report on what characters were discussed to form that argument and whether or not the other pair of students agreed or disagreed.</td></tr>
<tr><td colspan="2">Independent practice: Students are to consider, if there are difference in opinion between the two pairs of scientists, how could we come to the best answer?</td></tr>
</table>

<table>
<tr><td colspan="2">Learning area: Inquiry and Argumentation - Lessons 3 & 4</td><td>Date: 23/09/2016</td></tr>
<tr><td colspan="2">Topic: Key Indicators of Health
Key question: How can we assess whether an ecosystem is healthy?</td><td>OH & S
Basic Science Lab Safety rules and Appropriate online behaviour</td></tr>
<tr><td colspan="3">Learning objectives:</td></tr>
</table>

<table>
<tr><td colspan="2">By the end of the lesson students will have an understanding of how Scientists use key indicators as evidence to form an argument.</td></tr>
<tr><td>Anticipatory set:
Draw on students' prior knowledge by asking key questions:
How did you decide whether the picture was healthy in the previous lesson?
What did you use to support your argument?
If you were there, what else could you use as evidence?</td><td rowspan="6">Checking for understanding & feedback
Begin the class with a five minute recap of learning outcomes from previous lesson and today's double lesson
As students are researching scientific indicators, teacher is to move around the computer lab and question students to gauge understanding
Before stepping back to allow the discussion to begin, just to remind students how to be a respectful audience member and engage in the scientific discourse.
As students are discussing the list of the ten indicators that will be used, move around the groups prompting students to explain what they would expect to see and why.
If students become stuck for ideas, or only focus on one area of testing for example water quality, guide students towards other indications of health for example indicator species, diversity of life forms or vegetation levels.</td></tr>
<tr><td>Communicating learning objectives: Today we will be investigating methods scientists use to form their arguments.</td></tr>
<tr><td>Input, modelling & learning activities:
Students are to get back into their pairs and to go to the library or computer room to research scientific ways of determining health of systems, particularly freshwater systems.
Pairs are to take notes in their science inquiry exercise book of their research and then choose three indicators, that would suit the freshwater systems in the two pictures, and present their findings to the class
After all pairs have presented, students will conduct a whole class discussion to democratically select the top ten indicators to be used.
This list is to be copied into their science inquiry exercise books and for pairs to discuss what they would expect for each of these indicators in each of the two pictures.
Students are also to create possible suggestions as to what may contribute to the results found by the key indicators.</td></tr>
<tr><td>Guided practice:
Teacher to begin the class by refreshing achieved learning outcomes from the previous lesson, and to outline the learning outcomes for this double lesson. This is a very student centred lesson, with the teacher prompting occasionally, but mainly allowing the students to develop their respectful scientific discourse and argumentation skills. When the class has come up with their indicators the teacher is to ask students to consider what reasons may be behind these values. For example: Stream one low oxygen levels, what might this also influence? Or this freshwater stream has a lot of rubbish present, what could the reasons be?</td></tr>
<tr><td>Conclusion:
Students are to go home and consider the two pictures again for Homework and to ensure they bring their science inquiry exercise book next lesson as they will be developing an experimental design.</td></tr>
<tr><td>Independent practice: Students are to consider the original two pictures and write some dot points in their science inquiry note book as to possible explanations behind what they had decided as their observable indicators.</td></tr>
</table>

<table>
<tr><td colspan="2">Learning area: Inquiry and Argumentation – Lesson 5</td><td>Date: 27/09/2016</td></tr>
<tr><td colspan="2">Topic: Develop Experimental Design
Key question: How do we design an inquiry to be tested?</td><td>OH & S
Basic Science Lab Safety rules</td></tr>
<tr><td colspan="3">Learning objectives:
By the end of the lesson students will have a completed draft of their experimental design for testing the health of a fresh water system using their key indicators.</td></tr>
<tr><td colspan="2">Anticipatory set:
Draw on students' prior knowledge by asking key questions:
What is scientific experimental design? What elements is it made up of?
How do we make sure our design is accurate?
What is the subject of your inquiry?</td><td rowspan="7">Checking for understanding & feedback
Teacher to begin the class by focusing in on key elements of the design.
Walking around the pairs to ensure all students are on the right track with their design framework
While walking around the classroom to question students on what the data will be showing them and what the student may be able to infer.
Guiding students to consider repetitions of data collection and averaging out values. Guiding students to consider how they can make their design as accurate as possible
Checking for understanding by revisiting questions from the lesson sequence so far, before continuing the experimental design.
Teacher to collect all inquiry exercise books as a form of formative assessment and to ensure all students are on the right course.</td></tr>
<tr><td colspan="2">Communicating learning objectives: Today we will be further developing our understanding of freshwater ecosystems. We will be putting in practice what we have been learning so far about key indicators and inquiry and drawing on our previous experience in scientific experimental design.</td></tr>
<tr><td colspan="2">Input, modelling & learning activities:
Students are to get back into their pairs and go over their previous information on experimental design from a previous unit.
In these pairs they are two write up their experimental design, incorporating the key indicators developed in the previous lesson, to test the health of a freshwater system
The students are to write their design out in their inquiry exercise books including the use of scientific vocabulary and develop a data table, and to hand it into be approved by the teacher before the following lesson.</td></tr>
<tr><td colspan="2">Guided practice:
Teacher to begin the class by refreshing previous instruction on the elements that make up scientific experimental design, including aim, method and hypothesis. While the students are discussing the design with their partners the teacher is to prompt students about how they could record data found and what the data might suggest on the health of each system. This is designed to keep students on task and to be using the inquiry to provide evidence for an argument</td></tr>
<tr><td colspan="2">Conclusion:
Draw the class back together for a discussion and collect draft experimental design. Students may collect their inquiry exercise books at the end of the day with comments on possible improvements. The following lesson will be the beginning of the data collection.</td></tr>
<tr><td colspan="2">Independent practice: Students to collect their inquiry exercise books, adjusting their experimental design as required and get familiar with their own design before heading out to collect data. Students are also encouraged to reflect on how, when they obtain their data, they are to analyse and present.</td></tr>
</table>

<table>
<tr><td colspan="2">Learning area: Inquiry and Argumentation – Lessons 6, 7 & 8</td><td>Date: 29/09/2016
& 30/09/2016</td></tr>
<tr><td colspan="2">Topic: Data Collection – Excursion to Sites
Key question: How do we make sure we are collecting comparable data?</td><td>OH & S
Scientific Excursion, Water Safety and appropriate use of scientific equipment.</td></tr>
<tr><td colspan="3">Learning objectives:
By the end of these three lessons students will have collected all their data for their inquiry. This is a dynamic process, with students learning and improving as they move through the collection process.</td></tr>
<tr><td colspan="2">Anticipatory set:
Draw on students' prior knowledge by asking key questions:
Is it important to stick to our design?
How can we ensure that our recordings are accurate?
What needs to be kept the same each time we collect data?</td><td rowspan="6">Checking for understanding & feedback
Teacher to begin the class by asking the anticipatory set of questions to focus students' attention on their experimental design.
As the pairs are conducting their experiment the teacher is to move around groups questioning to assess understanding and levels of safe practice.
Teacher is to keep an eye out for students acting unsafely with the equipment.
Moving around the group, teacher to check results, questioning validity when necessary.</td></tr>
<tr><td colspan="2">Communicating learning objectives: Today we will be putting into practice the experimental design developed, and approved, from last lesson. The learning outcome for these three field-based lessons is for students to scientifically collect data from the test sites by following their experimental design.</td></tr>
<tr><td colspan="2">Input, modelling & learning activities:
Students are to firstly check over their experimental design and to make sure all equipment is present before getting on the school bus to the sites.
Once getting to the sites students are to lay out all equipment that it to be used and label and number it to avoid confusion between groups.
Students to take one measurement at a time, ensuring maximum reliability and record the measurement in their data table in their inquiry book.
Students will work through all indicators to be tested and to confer with other students before moving on to the next site.</td></tr>
<tr><td colspan="2">Guided practice:
These classes are field-work based practical classes so there is a high need for teacher supervision to ensure all students are working safely. However, the teacher is to take a step back from the inquiry process allowing the students to work collaboratively and to solve any problems that arise as scientists. In this practical sequence the teacher is to provide assistance using the equipment if students require. The teacher is also to walk around the site taking photos to help students when completing their data analysis and assessment piece.</td></tr>
<tr><td colspan="2">Conclusion:
At the end of each lesson, the teacher is to confirm that all pairs have collected all data points for the site before moving on, and then at the last site to check all data has been collected and all equipment returned. Before heading back to school at each site, a quick Q&A if students are unsure about some of their results and each pair is to join with another pair and choose one indicator to discuss and compare results.</td></tr>
<tr><td colspan="2">Independent practice: Students are to compile their data onto an excel spread sheet and email through to the teacher as to create a class average that will act to remove any potential outliers. Once</td></tr>
</table>

the class average has been developed the teacher will email the data and students are to compare their results with the class to test if they are reliable.	

Learning area: Inquiry and Argumentation – Lessons 9 & 10	**Date: 04/10/2016 & 06/10/2016**
Topic: Data Analysis and Argument Development **Key question:** What does the data tell us, what could we argue based on this data?	**OH & S** Basic Science Lab Safety rules and Appropriate online behaviour.
Learning objectives: *By the end of this lesson students will have completed their data analysis and begin to draw conclusions from the data. From these conclusions the pairs will form an argument based on the data about whether the freshwater ecosystems are healthy and the reasons behind the data values. Students can further strengthen their argument by using supportive literature.*	
Anticipatory set: Draw on students' prior knowledge by asking key questions: • What did you notice about the data we collected? • Did you see any big differences between the sites? • Did you see any similarities between the sites? • Are the freshwater ecosystems healthy?	**Checking for understanding & feedback** • Teacher to begin the class with a five minute discussion on what data was collected and what the students saw. • The teacher will then lead into the learning objectives of these two classes and introduce the assessment task. • As students begin to analyse their data, the teacher is to move around groups to check for understanding and to make sure students are comparing and contrasting appropriate data. • Asking students what they think is healthy and why?
Communicating learning objectives: Today we will be using the data we collected from the three sites, the two selected sites and the control, and compare and contrast the values found from our key indicators. In your pairs you are to form an argument as to whether the ecosystems are healthy with evidence to support your argument. The pairs are also to develop reasoning as to why they saw the recorded values for the indicators and to support these hypotheses with information from online research.	
Input, modelling & learning activities: • Students are to get back in their pairs and compare their data to the class averages to assess the validity of their data. • Students are to use Microsoft excel to plot their data from the two sites and to compare with the control site. • Students will talk in their pairs and confer with other students about the differences or similarities found in the collected data. • Students are to produce graphical representations of their data • Students are to then to develop their argument based on the evidence collected and research literature for supporting documents.	
Guided practice: The teacher will begin this class by recapping what we did on the field-based lessons and put up the photos on the smart board. The teacher is to guide the discussion towards the data collected and how the students could use the data collected to form an argument about the health of the freshwater ecosystem. The teacher is to introduce the summative assessment task that is a presentation in lessons 11 and 12 and what is required. Students are to use these two lessons to analyse their data and form an argument, based on evidence, as to whether the sites are healthy.	

Conclusion: At the end of these two lessons students will have their presentation ready to go to present to the class in the following two lessons. Students are encouraged to practice their argument to ensure they're ready and have strong evidence to back up their argument.	
Independent practice: Students are to reflect upon the strength of their evidence used to support their argument. Students are also to consider possible counterarguments to their position to be prepared for possible questions from the mock council.	

Learning area: Inquiry and Argumentation – Lessons 11 & 12	**Date: 07/10/2016**
Topic: Presentation of Argument **Key question:** Are the Freshwater ecosystems healthy?	**OH & S** Basic Science Lab Safety rules
Learning objectives: *By the end of this lesson students will have completed this inquiry and argumentation unit and will present to the mock council as summative assessment.*	
	Checking for understanding & feedback • Teacher is to facilitate the presentation and keep track of time per group. • At the conclusion of the presentation the teacher is to pose questions to the presenting pairs to gauge understanding of the argument • Teacher also to encourage audience engagement and participation by asking other pairs to consider the argument and pose questions or challenges.
Communicating learning objectives: Today we will be presenting our arguments as to whether the freshwater ecosystems are healthy. The aim is to convince the mock council, your classmates and teacher, using evidence that you have collected as the investigating scientist.	
Input, modelling & learning activities: • Students are to present, in their pairs, their argument based on evidence • Students can use, in their presentation, their data analysis and graphs to further demonstrate their evidence for the argument. • Students can also present supporting arguments from the literature reviewed. • Students are to act as the council and to provide feedback to pairs presenting and ask questions to show understanding.	
Guided practice: The teacher is to facilitate the running of the mock council and act as time keeper to keep students on track so everyone has time to present their argument. Teacher to assess all students against the marking rubric as their summative assessment for the unit (Appendix 2).	
Conclusion: All students are to be thanked for their work in this unit and for their support of others in the class. The teacher is to inform students of the marking process and when the students will receive their grades. In conclusion students are asked to reflect on what they have learnt about the nature of being a scientist and conducting a scientific inquiry. Students are to write a short paragraph in their inquiry books and hand these in to the teacher for the teacher to assess.	

References

Australian Curriculum Assessment and Reporting Authority. (2016, June 30). *The Australian Curriculum: Science* (Version 8.2),Year 9, all curriculum elements, all curriculum dimensions Retrieved from http://www.australiancurriculum.edu.au/download/f10

Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher education*, *32*(3), 347-364.

Grooms, J., Enderle, P., & Sampson, V. (2015). Coordinating Scientific Argumentation and the Next Generation Science Standards through Argument Driven Inquiry. *Science Educator*, *24*(1), 45.

Osborne, J. (2010). Arguing to learn in science: The role of collaborative, critical discourse. *Science, 328* (5977), 463-466.

Sampson, V., Grooms, J., & Walker, J. P. (2011). Argument-Driven Inquiry as a way to help students learn how to participate in scientific argumentation and craft written arguments: An exploratory study. *Science Education*, *95*(2), 217-257.

Appendix 1 – Pictures of Ecosystems to be debated.

Freshwater Ecosystem #1

Freshwater Ecosystem #2

Appendix 2 – Marking Rubric for Summative assessment.

	Below Standard	Approaching Standard	At Standard	Above Standard	Well Above Standard
Presentation Skills and Planning of Presentation	No eye contact with audience, difficult to understand due to volume of voice. No planning evident, miscommunication within group, all information read from presentation	Poor presentation skills, minimal eye contact with audience. Little evidence of planning with majority read of the presentation.	Satisfactory presentation for eye contact and volume of voice. Planning satisfactory with some reading directly from presentation.	Clear voice and good body language, eye contact with majority of audience. Good planning of presentation	Clear voice, excellent eye contact and body language. Well planned for and prepared for presentation
Content & Comprehension	Argument poorly developed, little or no supporting evidence for claims. No understanding demonstrated from presentation.	Partial development of argument, majority of claims made not supported by evidence. Limited understanding of topic presented, questions unanswered at the conclusion of presentation	Satisfactory development of argument, some claims unable to be supported with evidence. Satisfactory understanding of topic, questions posed attempted with some errors	Good development of Argument, majority of claims supported by evidence Good understanding of topic presented, able to answer questions posed with minimal errors	Strongly developed argument based on evidence Excellent understanding of topic presented, able to answer all questions posed
Audience Behaviour	No evidence of active listening, disrespectful behaviour towards other groups, constant interruptions to presentations requiring intervention from teachers.	Significant interruptions to other presentations, little or no active listening to other presentations.	Satisfactory audience member, some interruption to other presentations.	Engaged audience member and minimal interruption during presentations. Actively listening to other groups asking questions occasionally	Highly engaged audience member and respectful towards other groups. Silence during presentations and active within question time.