Education

ECM501
Teaching the Curriculum: Junior Secondary Science

Credit Points:	10	**Mode:**	Internal/External delivery
Assumed Knowledge:	NA	**Location:**	Casuarina Campus /Learnline
Pre-Requisite(S):	NA	**Learning Method:**	Face to Face /OLR
Year:	2021	**Unit Coordinator:**	Dr Muhammad Nawaz
Semester:	One/Two	**Phone:**	(08) 8946 6277
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Please see your learnline unit for the lecturer's contact details			

UNIT DESCRIPTION

In this postgraduate unit, pre-service teachers will develop in-depth specialised pedagogical knowledge and skills to demonstrate an understanding of the complexities of student learning in junior secondary science. Pre-service teachers will review the contemporary science educational theories and literature to think critically and challenge their own and peers' existing knowledges of the concepts and processes of teaching and learning of junior secondary science using the Australian Curriculum in Science throughout this unit.

LEARNING OUTCOMES

On successful completion of this unit students should be able to:

1. Synthesise complex interrelationships in pedagogical content knowledge in the design and implementation of engaging learning experiences in junior secondary science classrooms.
2. Implement and analyse Indigenous knowledge across a range of real-world contexts in science teaching and learning in junior secondary.
3. Critically analyse a range of creative and challenging scientific inquiry approaches in teaching and learning.
4. Analyse and theorise the dynamic and interconnected nature of real-world problems through engagement in research literature and evaluation of students' science learning experience.
5. Articulate and implement safe working practices in science activities in and out of the classroom.

TEACHING AND LEARNING STRATEGIES

Learning and teaching will include individual and collaborative activities to enhance the synthesis of the complex interrelationships within the pedagogical content knowledge of junior secondary science education. Learnline modules provide the learning materials to challenge current understanding of teaching and learning in science and its relationship to scientific inquiry, and science as a human endeavour. Activities within the learning materials provide specific activities along with exemplars, graphics, visualisations and Collaborate sessions.

The unit presents opportunities to analyse and critique Australian Curriculum: Science documents individually and as a group. Pre-service teachers will use creative and challenging inquiry methodologies to ensure a relational understanding of real world problems and local contexts are constructed for classroom practice. They will also identify and use of relevant digital resources to explore the dynamic and interconnected nature of learning in science. Access to all unit learning and teaching activities will be available through Learnline.

PARTICIPATION

This unit requires approximately 12.5 hours (based on Units and Course Policy, pol-057) of commitment per week over the 12-week semester with an expectation of interaction with peers using Learnline. This forms an important means of developing their professional language and reflecting one's own and the work of others. In line with professional practice, collaborative learning is encouraged. Aside from personal matters, student-to-lecturer communication will occur within a broader collaborative context where student-to student communication predominates. Lecturer input to this context is expected to be advisory, with students taking the initiative and developing their skills in leadership, problem solving, and consensus building. Specific details of individual class times can be obtained by accessing the class timetable at: http://www.cdu.edu.au/timetable

LEARNLINE

Learnline will be used to provide information about study requirements including detailed assessment information, to post announcements about the unit and to distribute learning materials. Assignments will be downloaded into Learnline and students will access feedback from tasks and grades. Students will also be provided with opportunities to communicate with their tutors and peers on discussion boards. Learnline provides a place where students can contribute to discussions on important issues relating to the unit especially assessment tasks.

Academics will:

1. Provide information about study requirements, including detailed information about assessment
2. Post announcements about the unit
3. Provide feedback on student tasks and grades for assessable work
4. Contribute to discussions, including those about assessment, and to interact with students in the unit.
5. Arrange 'real time' seminars/classes

Pre-Service teachers will:

1. Post to forums
2. Submit assessment tasks
3. Provide feedback on the posts of others
4. Receive and send email
5. Download/upload multimedia
6. Access Learnline to interact with lecturers and other students
7. Participate in real time seminars/classes

ADDITIONAL EDUCATIONAL RESOURCES

MARK REVIEWED BUTTON

The mark reviewed button is an important feature of most Education units. Because it allows students access to the next section of the learning material, for example you will need to review the plagiarism declaration before you can gain access to your assignments. New content will be released once the 'mark reviewed button has been selected.

INCORPORATING INDIGENOUS KNOWLEDGES

The School of Education is committed to incorporating localised and national contemporary Indigenous Knowledges into all units and course programs. In this unit students will develop their current understandings of Indigenous Knowledge as it relates to the education sector. Course content delivered to students will acknowledge the diversity of Indigenous people's cultures and knowledges. This unit acknowledges that Indigenous perspectives are *ways of knowing, being and doing,* that is based in technology, the land and the culture articulated by Aikenhead and Ogawa (2007) where they suggest that these perspectives highlighted by:

Knowledge and the knower are connected, Journey: coming to know, Place-based, Verb rich, process and action orientated, Inter-related, Specialised: understanding the interconnections.

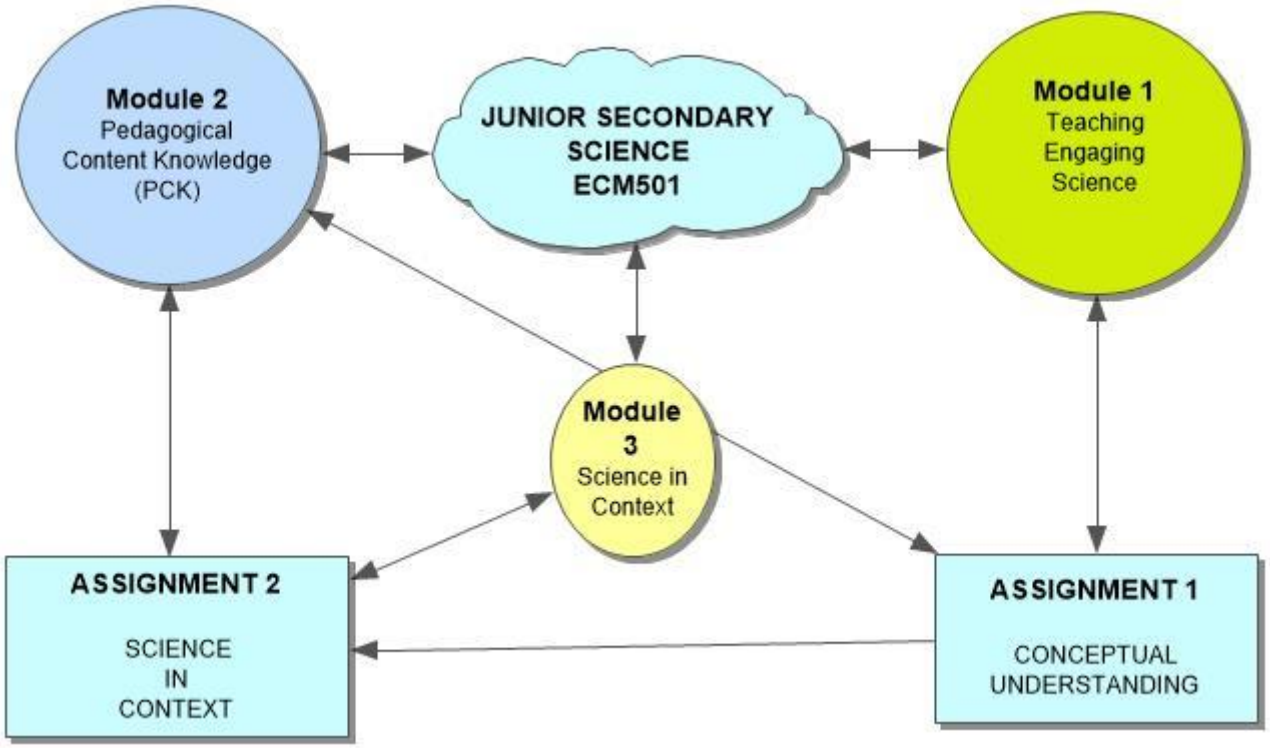
Pre-service teachers will be provided opportunities to explore Indigenous perspectives and pedagogies from Indigenous teachers and academics and apply these theoretical concepts to their own teaching practices.

INSCHOOL (PLACEMENT INFORMATION)

Students completing units that require placement should visit the Inschool site http://inschool.cdu.edu.au for placement information. This includes calendars of dates, requirements for the placement and assessment forms to be returned at the completion of the placement.

Note that assessment forms are returned to the placement office (http://inschool.cdu.edu.au) and are not uploaded to Learnline

UNIT OVERVIEW



LEARNING SCHEDULE

Module 1 : Teaching Engaging Science				
Estimated time frame	Topic	Tutorial activities	Student Preparation/content	Unit LO & AITSL,
1-4	Topic 1.1: Science in the Jnr Secondary curriculum	Activity 1.1.1: Quality of teaching and Learning in Science An investigation of the relationship between pedagogical content knowledge as a frame for teacher quality	Pedagogical Content knowledge: as a conceptual tool for teachers as professionals: Is it important?	LO:1,2,3,4,5 APST: 1.2,2.1,2.2 2.3, 2.4, 2.6, 3.2,4.1,4.2, 4.4,4.5,5.1,5.2,5.3,6.1, 7.2
	Topic 1.2: Australian Curriculum	Activity 1.2.1: Science as understanding: making meaning of discipline content. Activity 1.2.2: Science as Inquiry: Meanings of the nature of science and its impact on classroom practice. Activity 1.2.3: Science as a Human Endeavour: what it means to teaching science in and about the universe.	Australian Curriculum Science, V 8.3 (ACARA, 2015)	

	Topic 1.3: Indigenous perspectives	Activity 1.3.1 Official knowledge and re-conceptualisation An investigation to answer the question: Is Indigenous perspectives relevant to the science classroom?	Scientific and Cultural knowledge Knowing being and doing	
	Topic 1.4: Duty of Care	Activity 1.4.1 Risk Assessment: understanding the place of 'loco parentis' in science	State and Territory risk management in curriculum activities and Occupational Health and Safety manuals and procedures.	
	In addition to discussion board tasks, each module has a critical task that provides opportunities for making judgements about learning progression. **Critical Task 1:** Pedagogical content knowledge provides a frame for developing quality science teaching practice. The task requires you to reflect on the model of pedagogical content knowledge and your understanding of the curriculum descriptors you have developed through Module 1. This reflection will present the gaps in your knowledge and suggestions for addressing the gaps. Your reflection and action plan for addressing the gaps will be presented by you on-line. Then, groups will be formed to provide support for your 'gap closing'.			
Module 2: Pedagogical Content Knowledge				
Estimated time frame	**Topic**	**Tutorial activities**	**Student Preparation/content**	**Unit LO & APST,**

5-09	Topic 2.1: Chemical Sciences	Activity 2.1.1: Scope and Sequence: structure and organisation of chemistry curriculum	Australian Curriculum Science, V 8.3 (ACARA, 2015)	LO:1,2,3,4,5 APST: 1.2,2.1,2.2 2.3, 2.4, 2.6, 3.2,4.1,4.2, 4.4,4.5,5.1,5.2,5.3,6.1, 7.2
		Activity 2.1.2: Alternative conceptions and conceptual change learning and assessment strategies.	NSDL Science literacy maps: Matter, change, energy Models in Chemistry: Macroscopic to sub-microscopic, Data handling, Analogies in chemistry, models and explanations	
		Activity 2.1.3: Engaging students: planning, sequences and pedagogical approaches in chemical science to challenge student alternative conceptions	Concept cartoons 5Es Teaching and Learning Model (Academy of Science) Extending and refining Knowledge (Mazarno & Pickering, 2006) Learning objects: ICT representations Data Logging	
	Topic 2.2: Biological Sciences	Activity 2.2.1: Scope and Sequence: structure and organisation of biology curriculum	Australian Curriculum Science, V 8.3 (ACARA, 2015)	
		Activity 2.2.2: Alternative conceptions and conceptual change in the biology classroom.	NSDL Science literacy maps: Systems, living things, relationships Role-play	

		Activity 2.2.3: Engaging students: planning, sequences and pedagogical approaches in chemical science to challenge student alternative conceptions	Sustainability: Australian Curriculum Science (ACARA, 2012) Using Knowledge meaningfully (Mazarno & Pickering, 2006) Blooms Taxonomy Patterns, order and organisation Form and Function	
		Activity 2.2.4: Indigenous perspectives: investigation of the place of Indigenous knowledge in Biology	Indigenous weather and seasons Knowledge (Bureau of Meteorology)	
	Topic 2.3: Physical Sciences	Activity 2.3.1: Scope and Sequence: structure and organisation of physics curriculum	Australian Curriculum Science, V 8.3 (ACARA, 2015)	
		Activity 2.3.2: Alternative conceptions and conceptual change learning and assessment in the physics classroom.	NSDL Science literacy maps Force, energy, electricity Data logging	
		Activity 2.3.3: Problem based learning and numeracy: strategies and pedagogical approaches for classroom engagement	Concept cartoons Problem-based learning Science inquiry	

		Activity 2.3.4: Indigenous perspectives: changes and transformations	Indigenous peoples and their knowledge in Science	
	Topic 2.4: Earth & Space Science	Activity 2.4.1: Scope and Sequence: structure and organisation of earth & space science curriculum	Australian Curriculum Science, V 8.3 (ACARA, 2015)	
		Activity 2.4.2: Alternative conceptions and conceptual change learning and assessment in the E & SS classroom	NSDL Science literacy maps Concept Maps Models of process Scale and Measurement	
		Activity 2.4.3: Problem based learning and numeracy: strategies and pedagogical approaches for classroom engagement	5Es Teaching and Learning Model: backward mapping Extending and refining Knowledge (Mazarno & Pickering, 2006) Learning Objects: ICT representations	
		Activity 2.4.4: Indigenous perspectives: changes and transformations	Australian Aboriginal Astronomy (CSIRO) Indigenous Weather Knowledge (Bureau of Meteorology)	
		In addition to discussion board tasks, each module has a critical task that provides opportunities for making judgements about learning progression. **Critical Task 2:**		

		Firstly this task is a follow-on from the first critical task in that you are required to report your progress on achieve your 'gap goal'. Then, you are required to reflect on the discipline knowledge and strategies of Module 2. This reflection will again present gaps in your knowledge and provide opportunities for addressing the gaps. Your reflection and action plan for addressing the gaps will be presented by you on-line. Then, groups will be formed to provide support for your 'gap closing'. They may not be the same groups as before, as the peer experts might be different. You again will be collaborating with your peers to develop your understanding of the content and strategies you will need as a science teacher.	

Module 3: Science in Context				
Estimated time frame	**Topic**	**Tutorial activities**	**Student Preparation/content**	**Unit LO & APST**
10-12	Topic 3.1: Local Place contexts	Activity 3.1.1: Big Issues of the future: bringing classroom science into a world of problem solving. Activity 3.2.1: Issues from my local area: bringing the world into science classroom problem solving.	Key ideas of Science: Patterns, order and organisation, Form and Function, Stability and change, Systems Matter and Energy and Scale and measurement	LO:1,2,3,4,5 APST: 1.2,2.1,2.2 2.3, 2.4, 2.6, 3.2,4.1,4.2, 4.4,4.5,5.1,5.2,5.3,6.1, 7.2
	Topic 3.2: What about mathematics?	Activity 3.2.1: Mapping the mathematics for Junior Science: making meaning of the	Australian Curriculum Mathematics V8.3 (ACARA,2015)	

In addition to discussion board tasks, each module has a critical task that provides opportunities for making judgements about learning progression.

Critical Task 3:

This is the final task where you will present to your peers an on-line a visualization the represents your professional learning journey of addressing your identified gaps in knowledge and understanding.

		relationships between maths and science.		

READINGS

Topic 1	Tutorial activities	Readings
Topic 1.1: Science in the Jnr Secondary curriculum	Activity 1.1.1: Quality of teaching and Learning in Science	Students' ease in Crossing Cultural Borders into School Science (Aikenhead, 2001). Re-Imagining Science Education: Engaging students in science for Australia's Future (Tytler, 2007) Park, S. and Oliver, J. (2008), Revisiting the Conceptualization of Pedagogical Content Knowledge: PCK as a conceptual tool to understand teachers as professionals. Research in Science Education, 38: 261-284. Berry, A., Loughran J., and Van Driel, J. (2008), Revisiting the Roots of pedagogical Content Knowledge. International Journal of Science Education, 30(10), 1271-1279. Van Driel, J., and Berry, A. (2012). Teacher Professional Development focusing on Pedagogical Content Knowledge. Educational Researcher, 41(1), 26-28

Topic 1.2: Australian Curriculum	Activity 1.2.1: Science as understanding Activity 1.2.2: Science as Inquiry Activity 1.2.3: Science as a Human Endeavour	Australian Curriculum Mathematics V8.3 (ACARA,2015) *Science by Doing (Australian Academy of Science)* *Science by Doing: Doing Science Investigations: teacher guide,* *Science by Doing: Doing Science Investigations: student guide,* *Science by Doing: Do it yourself (DIY)-adapting science lessons to an inquiry-based approach: teacher guide.*
Topic 1.3: Indigenous perspectives	Activity 1.3.1 Official knowledge and reconceptualisation	Gondwe, M and Longnecker, N. (2015). Scientific and Cultural Knowledge in Intercultural Science Education: Student Perceptions of Common Ground. Research in Science Education, 45(1): 117-147.
Topic 1.4: Duty of Care	Activity 1.4.1 Risk Assessment	State and Territory risk management in curriculum activities and Occupational Health and Safety manuals and procedures.
Topic 2	**Tutorial activities**	**Readings**
Topic 2.1: Chemical Sciences	Activity 2.1.1: Scope and Sequence	Australian Curriculum Science, V 8.3 (ACARA, 2015)
	Activity 2.1.2: Alternative conceptions and conceptual change learning and assessment	NSDL Science literacy maps Models in Chemistry: https://www.rsc.org/cpd/resource/RES00001448/developing-and-using-models
	Activity 2.1.3: Engaging students: planning and sequences	5Es Teaching and Learning Model: Science by Doing (Australian Academy of Science) Extending and refining Knowledge, Mazarno & Pickering, 2006 Learning objects: ICT representations

		Pedagogical approaches technology-integrated science teaching Data Logging: The use of data logging in teaching chemistry and physics (Kennedy, 2000)
Topic 2.2: Biological Sciences	Activity 2.2.1: Scope and Sequence	Australian Curriculum Science, V 8.3 (ACARA, 2015)
	Activity 2.2.2: Alternative conceptions and conceptual change learning and assessment	NSDL Science literacy maps Role-play: Role-playing as a creative method in science education (Craciun, 2010)
	Activity 2.2.3: Engaging students: planning and sequences	Sustainability: Australian Curriculum Science (ACARA, 2012) Using Knowledge meaningfully (Mazarno & Pickering, 2006) Blooms Taxonomy: Biology in Bloom: Implementing Bloom's Taxonomy to enhance Students Learning in Biology (Crowe et al., 2008).
	Activity 2.2.4: Indigenous perspectives	Indigenous weather and seasons Knowledge (Bureau of Meteorology) Indigenous Science Network
Topic 2.3: Physical Sciences	Activity 2.3.1: Scope and Sequence	Australian Curriculum Science, V 8.3 (ACARA, 2015)
	Activity 2.3.2: Alternative conceptions and conceptual change learning and assessment	NSDL Science literacy maps Inside the black box: Raising Standards through classroom assessment (Black and William, 2001)
	Activity 2.3.3: Problem based learning and numeracy	Concept cartoons: Concept Cartoons in Science Education (Naylor & Keogh, 2000) Problem-based learning: Problem based learning and the nature of science (Moutinho et al, 2015) Science inquiry: Science by Doing (Australian Academy of Science)

	Activity 2.3.4: Indigenous perspectives: changes and transformations	Hogue, M. (2016) Aboriginal Ways of Knowing and Learning, 21st Century Learners, and STEM Success.
Topic 2.4: Earth & Space Science	Activity 2.4.1: Scope and Sequence	Australian Curriculum Science, V 8.3 (ACARA, 2015)
	Activity 2.4.2: Alternative conceptions and conceptual change learning and assessment	NSDL Science literacy maps Concept Maps: Concept mapping: A useful tool for science education (Novak, 1990). Models of process: Models and Modelling in Science Learning (Rapp and Sengupta, 2010) Science years 7-10 Assessment Strategies: NSW Department of Education
	Activity 2.4.3: Problem based learning and numeracy	5Es Teaching and Learning Model: backward mapping Extending and refining Knowledge: Mazarno & Pickering, 2006 Learning Objects: ICT representations
	Activity 2.4.4: Indigenous perspectives: changes and transformations	Australian Aboriginal Astronomy (CSIRO) Indigenous Weather Knowledge (Bureau of Meteorology)
Topic 3	**Tutorial activities**	**Student Preparation**
Topic 3.1: Local Place contexts	Activity 3.1.1: Big Issues of the future Activity 3.2.1:Issues from my local area	Key ideas of Science: Australian Curriculum Science, V 8.3 (ACARA, 2015)

Topic 3.2: What about mathematics?	Activity 3.2.1: Mapping the mathematics for Junior Science	Australian Curriculum Mathematics V8.3 (ACARA, 2015)

ASSESSMENTS

Assignment 1	
Title	Conceptual Understanding
Value	50 %
Week Due	Week 6
Length	2000 words or equivalent
Learning Outcomes	1,2,3; APST: 1.2, 2.1, 2.6, 3.2, 3.3, 3.4, 4.1, 4.4

Task Description

This assignment requires you to demonstrate research, technical and creative skills to design four science investigative activities. The four activities will be based on your research of student alternative conceptions in science relating to the sub-strands: Chemical, Biological, Physical and Earth/Space science of the Australian Curriculum. This means: one alternative conception and activity per sub-strand. These are not lesson plans.

The activities you create will demonstrate the synthesis of complex relationship between student alternative conceptions, student engagement and investigation theories in science education. This is best done by assuming students hold a particular alternative conception and your activity will through the results of the investigation challenge the particular alternative conception.

These investigative activities will use *working scientifically* protocol relevant to your State or Territory.

PART B:

After you have created your activities, you must demonstrate your technical and communicative skills to implement, analyse, evaluate and theorise the effectiveness of **one** investigation. This might be conducted with students, family, and friends or by yourself.

You will need to:

- Present a theoretical justification context that frames the investigation relevant to the student cohort,
- State the target level(s) of the students you are designing for;
- Identify the science and mathematics sub-strands and content descriptions you are using;
- Identify the appropriately referenced student alternative conceptions;
- Present the activities using the *working scientifically*;
- Present a risk assessment for the activity you perform,
- Demonstrate of conducting one activity,

- Use feedback and observations from the *performed* investigation to critically reflect place of student alternative conceptions as a focus for student engagement in the science investigative classroom.

ASSIGNMENT 1 ECM501 GRADING CRITERIA

	HD 100-85	D 84-75	C 74-65	P 64-50	F <50
Context or narrative to frame the investigations relevant to the student levels	Context or narrative demonstrate highly creative ideas, stated in effective, sharp language Relevance of student alternative conceptions is established and supported in detail from the literature for the student activities. highly developed structured argument for relevance and engagement; fully developed implications for student engagement	Context or narrative demonstrate creative ideas, stated in effective, sharp language Relevance of student alternative conceptions is established through the literature for the student activities. A developed structured argument for relevance and engagement; A development of implications for student engagement	Context or narrative demonstrate ideas, stated in effective language Relevance of student alternative conception is established for the student activities with some literature. Evidence of structured argument for relevance and engagement; evidence of the development of implications for student engagement	Context or narrative ideas are present. Relevance of student alternative conception is established for the student activities. Some evidence of structured argument for relevance and engagement; Some development of implications for student engagement	Context or narrative ideas are absent. Relevance is not established for the student activities. No evidence of structured argument for relevance and engagement; No development of implications for student engagement
Identify the strands/domains and outcomes	Science and Mathematics Strands/domains are identified correctly. Outcomes are appropriate				Strands/domains are identified incorrectly. Outcomes are inappropriate

Alternative conceptions and engaging students	Student alternative conceptions and concepts of student engagement are clearly articulated, complete and are creatively used for the stated activities. Highly developed connections made to prior learning, student alternative conceptions and the stated activities. Presentation of activities has the potential to stimulate interest and motivate student to challenge their understandings.	Student alternative conceptions and concepts of student engagement are articulated, complete and are appropriate for the stated activities. Connections are made to prior learning, student alternative conceptions and the stated activities. Presentation of activities has the potential to stimulate interest and motivate student to challenge their understandings.	Student alternative conceptions and concepts of student engagement are articulated and are appropriate for the stated activities. Connections are made between student alternative conceptions and the stated activities. Presentation of activities has the potential to challenge student understandings.	Student alternative conceptions and concepts of student engagement are stated/implied for the activities. Connections are made between student alternative conceptions and the stated activities, but some links are tenuous/implied. Presentation of activities has some potential to challenge student understandings.	Student alternative conceptions and concepts of student engagement are not stated for the activities. Connections are not made between student alternative conceptions and the stated activities Presentation of activities has little potential to challenge student understandings.
Safety/student management issues.	A detailed account of safety/student management issues are provided			Accounts of safety/student management issues are provided/implied	An account of safety/student management issues are not evident.

Demonstration of conducting one activity	Evidence of conducting one activity is appropriate. Critique of problems is appropriate, with a detailed evaluation of the conceptual challenge.		Evidence of conducting one activity is appropriate. Critique of problems is appropriate, with an evaluation of the conceptual challenge.		No Evidence of conducting one activity. lacking detail Critique of problems
Critical reflection Analysis synthesis Interpretation justification	Comprehensive, insightful and valid reasoning. All aspects presented in depth and with strong insight Significance, strengths and weaknesses are comprehensively addressed and circumstantiated Key challenges clearly identified, comprehensively explained and rationale justified Numerous appropriate references from a wide range of sources used	Comprehensive and valid reasoning. Aspects presented in depth Significance, strengths and weaknesses comprehensively Addressed. Key challenges clearly identified and explained Numerous appropriate references	Mostly valid reasoning Credible aspects are presented in appropriate depth Significance, strengths and weaknesses are present. Key challenges clearly identified and briefly explained Several appropriate references used	Some valid reasoning Few aspects presented in appropriate depth. Significance, strengths and weaknesses partially addressed Some challenges clearly identified Few appropriate references used	Invalid or no reasoning Aspects of approach are minimally presented Significance, strengths and weaknesses minimally addressed challenges vaguely identified No or inappropriate references used

Assignment 2	
Title	Science in Context
Value	50%
Week Due	Week 12
Length	2000 words or equivalent
Learning Outcomes	3,4,5

Task Description

This assignment requires you to design two scientific investigations based on a local problem or issue that links **science**, **mathematics** and **technology**. The **science**, **mathematics** and **technology** content description must come the Australia Curriculum.

When you have decided the problem or issue from your local area, you will need to,

- Use appropriate methodology to 'find out' the problems in your local area. Then analyse the data to present a coherent and sustained argument for the choice of a particular problem to investigate in terms of a year 9 student's interest,
- Outline sub-strands, content descriptions you will use for the three curriculum areas in the planning the two scientific investigations for your students,
- Present your investigations and include working scientifically, then
- Preform ONE of the investigations and present
    - all data/results: tables and graphs,
    - experimental analysis and conclusions ,
    - demonstration of an understanding of the science concepts,
- Critique of the scientific investigation relevance and student difficulties

This assignment is about the quality and creativity of the tasks, keeping in mind the outcome is to engage and activate year 9 classroom learners.

ASSIGNMENT 2 ECM501 GRADING CRITERIA

	HD 100-85	D 84-75	C 74-65	P 64-50	F <50
Local issue and the curriculum	Problem research clear, focused, creatively approached and innovative, Background & relevant works with detailed analysis and interpretation Relevant problem/issue, creative & substantial use of the curriculum links.	Problem research clear, focused and innovative, Background & relevant works presented and analyzed Relevant, accurate, & substantial use of curriculum links	Problem research present but not clear, focused or made explicit Background & relevant works superficially surveyed Generally relevant and accurate use of the curriculum links.	Problem research present but not clear, focused or made explicit Background & relevant works superficially surveyed Relevant and sometimes not specific use of the curriculum links.	Superficial and not specific. Little attempt to use of the curriculum links.
	Demonstrates flair, originality and creativity in the synthesis of investigations to engage with the local issue.	Demonstrates coherent and consistent synthesis of investigations to engage with the local issue.	Demonstrates consistency in the synthesis of investigations to engage with the local issue.	Demonstrates a basic level of consistency in the synthesis of investigations to engage with the local issue.	Demonstrates little understanding in synthesis of investigations and the relationship to the local issue.

Science strands/domainsand outcomes	Strands/Sub-strands, Content Description, Elaborations are identified correctly. Outcomes are appropriate	Strands/ Sub-strands, Content Description, Elaborations are identified correctly, but some are incomplete	Strands/ Sub-strands, Content Description, Elaborations are identified incorrectly/not apparent.
Mathematics strands/domainsand outcomes	Strands/Sub-strands, Content Description, Elaborations are identified correctly. Outcomes are appropriate	Strands/ Sub-strands, Content Description, Elaborations are identified correctly, but some are incomplete	Strands/ Sub-strands, Content Description, Elaborations are identified incorrectly/not apparent
Technology Strands/domain and outcomes	Strands/Sub-strands, Content Description, Elaborations are identified correctly. Outcomes are appropriate	Strands/ Sub-strands, Content Description, Elaborations are identified incorrectly/not apparent	Strands/ Sub-strands, Content Description, Elaborations are identified incorrectly/not apparent

Working Scientifically **Experiments engage students**	Experiment uses the working scientifically and is highly integrated and clearly stated, with learners having a clear understanding of what is expected. Demonstrates a very highly articulated understanding of working scientifically Activity is designed to creatively stimulate, engage and motivated students using the working scientifically	Experiment uses working scientifically: clearly stated, with learners having a clear understanding of what is expected. Demonstrates a high level understanding of working scientifically Activity is designed to stimulate, engage and motivated students using the working scientifically	Experiment uses working scientifically, clearly stated, with learners having a clear understanding of what is expected. Demonstrates an understanding of working scientifically Designed to stimulate, engage and motivated students using the working scientifically	Experiment uses working scientifically stated, with earners having some understanding of what is expected. Demonstrates some understanding of working scientifically Some designed to stimulate, engage and motivated students using the working scientifically	No use the working scientifically Demonstrates little understanding of working scientifically, No activities are designed to stimulate, engage and motivated students using the working scientifically
Safety/student management issues.	A detailed account of safety/student management issues are provided			Accounts of safety/student management issues/strategies are provided and are limited	An account of safety/student management issues/strategies is not provided.

Data, results, and graphs	Data is presented in tabular form, results are clearly articulated, and graph presents data in a clear and concise manner. Accurate observations and interpretations of data.			Data is presented in tabular form, results are articulated, graph presents data, some issues in presentation; graph, table or both	Data is not presented in tabular form, results are not clearly articulated, graph presents little data Not implicit stated or absent
Conclusions	Conclusion is clearly articulated, complete, stated in scholarly language. Highly developed and detailed connections between data, results, graphs and the science concept(s).	Conclusion is clearly articulated, complete, stated in scholarly language. Well-developed connections between data, results, graphs and the science concept(s).	Conclusion is clearly articulated stated in scholarly language. Demonstrates connections between data, results, graphs and the science concept(s).	Conclusion is articulated, some ambiguity in explanations Demonstrates simple connections between data, results, graphs and the science concept(s).	Conclusion is not well articulated, ambiguity in explanations or missing with little demonstrated understanding of the connections between data, results, graphs and the science concept(s).

Reflection on the investigation	Reflection demonstrates highly developed conceptual understanding of organizational and student issues, stated in effective sharp language. Uses wide range of referenced sources in the demonstration of conceptual understanding. Relevance is established for the student activity with a very detailed understanding of student organizational issues, with fully developed implications for student engagement Assumptions of relevance and student difficulties are clearly stated; Presents a highly developed and structured argument for relevance for student engagement	Reflection demonstrates highly developed conceptual understanding, stated in effective sharp language with sources acknowledged. Relevance is established for the student activity with a detailed understanding of student organizational issues, with developed implications for student engagement Assumptions of relevance and student difficulties are clearly stated; Presents a well-developed and structured argument for relevance for engagement and student issues.	Reflection demonstrates conceptual understanding, stated in effective language with sources acknowledged. Relevance is established for the student activity with an understanding of student organizational issues, and implications for student engagement Assumptions of relevance and student difficulties are clearly stated; Presents a structure for relevance for engagement and student issues.	Reflection demonstrates some conceptual understanding, Relevance is not clearly established for the student activity with some understanding of student organizational issues, and implications for student engagement Some presentation of an argument for relevance for engagement and student issues.	Reflection demonstrates little conceptual understanding. Relevance is not clearly established for the student activity with little understanding of student organizational issues, and implications for student engagement Not implicit stated or absent

Science Concept(s)	Demonstrates highly developed conceptual understanding. Extensive and creative demonstrations of the linking of a number of science concepts and experiment.	Demonstrates highly developed conceptual understanding. Demonstrates the linking of a number of science concepts and experiment.	Demonstrates conceptual understanding. Demonstrates some linking of a number of science concepts and the experiment	Demonstrates some conceptual understanding.	Demonstrates little conceptual understanding. Not implicit stated or absent