

ACER Portfolio Project

TEACHING FIELD: Secondary Science
LEVEL: Highly Accomplished

ENTRY 3: Science Investigation and Inquiry

The ACER Portfolio Project focuses on the research and practical challenges involved in developing valid and feasible methods by which teachers can demonstrate how they meet the Australian Professional Standards for Teachers at the highly accomplished level. Entry 3 is one of four portfolio entries for secondary science teachers.

© The Australian Council for Educational Research Ltd (ABN: 19 004 398 145)
2015. All rights reserved.

ENTRY 3: Science Investigation and Inquiry

Introduction

Highly accomplished science teachers engage students in comprehensive scientific investigations and inquiries that develop their ability to formulate researchable questions, analyse evidence and evaluate claims. They develop students' ability to distinguish opinion from fact and science from pseudo-science.

Highly accomplished science teachers of science model the excitement, challenge and rigour of science; they help their students to make connections between science inquiry skills, the work of scientists and the relevance of such skills to decision-making in their own and others' lives.

They use a broad range of teaching methods, such as multimedia, modelling or simulations to promote and consolidate students' science inquiry skills. They incorporate current issues and case studies that develop students' appreciation of the relevance of science to everyday life of individuals, communities and societies. They provide opportunities for students to articulate questions and make predictions that can be investigated or tested. They promote student collaboration in their investigations, in and out of the classroom.

The highly accomplished science teacher designs learning environments that enable students to design investigations that involve planning, data collection, analysis and evaluation of findings. They are able to utilise strategies to develop students' skills in drawing evidence-based conclusions.

The highly accomplished science teacher provides opportunities for students to communicate their findings to various audiences and to use forms of communication relevant to different audiences and to the material they are communicating.

Throughout all phases of their students' investigations, highly accomplished teachers of science monitor and evaluate their students' progress in developing their inquiry skills and apply intervention strategies as appropriate.

Highly accomplished teachers maintain the currency of their science knowledge and pedagogy in relation to teaching and learning the skills of science inquiry and investigation. They engage in purposeful professional learning that is based on an analysis of their practice, the learning of their students and authoritative research findings.

Overview of the entry

In this portfolio entry you will demonstrate how you:

1. Develop teaching plans that set long- and short-term learning goals for student outcomes referenced to the Australian Curriculum: Science,
2. Establish and manage learning environments and activities that promote scientific investigation and inquiry and relate to meaningful contexts,
3. Engage students purposefully in collaborative science investigations that develop their scientific inquiry and their knowledge and understanding of important concepts in science

You will provide evidence by means of:

- A 15-20 minutes film recording, showing evidence of your students purposefully engaged in their investigations and your role in furthering their science inquiry skills.

- Teacher artefacts and teaching materials used to assist and guide students in their investigations. These will help to the reader to understand the activities shown in the video segment and how the work that the groups have undertaken has been supported.
- A written commentary that:
 - describes the context of your teaching, your teaching plan, and your reasons for selecting the film segment;
 - points to and analyses evidence in the film segment of student engagement in collaborative investigation and development of inquiry skills; and
 - reflects on the evidence in the film segment about your teaching and learning outcomes and their implications for future teaching of inquiry skills.

Note: this entry should be based on a different unit of work and a different class from your other portfolio entries

How the entry task is designed and why

This entry is designed to enable you to provide evidence of how you meet the standards for highly accomplished teachers in your current teaching context, how you provide quality learning opportunities related to the Australian Curriculum: Science and how you draw on relevant research.

This entry does not prescribe how you will teach the skills for scientific inquiry, the type of investigation to use or the kind of opportunities you provide. The methods and strategies used depend on your professional judgment and is related to the circumstances in which you are teaching and what your students require.

The entry is referenced to:

1. The Australian Professional Standards for Teachers (AITSL) at the Highly Accomplished career stage.
 - a. <http://www.aitsl.edu.au/australian-professional-standards-for-teachers/standards/career-stage/highly-accomplished>
 2. The Australian Curriculum: Science (AC:S).
<http://www.australiancurriculum.edu.au/science/rationale>
1. Research on best practice for teaching and learning science. Australian Professional Standards for Teachers, Australian Institute for Teaching and School Leadership (AITSL), Relevant to Entry 3

This entry requires you to provide evidence of your accomplishment relevant to the following *Australian Professional Standards for Teaching* at the Highly Accomplished career stage

- Standard 1: Know students and how they learn
- Standard 2: Know the content and how to teach it
- Standard 3: Plan for and implement effective teaching and learning
- Standard 4: Create and maintain supportive and safe learning environments
- Standard 5: Assess, provide feedback and report on student learning
- Standard 6: Engage in professional learning

An emphasis for this entry is on Standards 1, 2, 3 and 4 although your entry will also provide evidence in relation to Standards 1, 5 and 6.

2. Australian Curriculum: Science

The overall **aims** and **content structure** of the science curriculum are clearly articulated. <http://www.australiancurriculum.edu.au/science/aims> and <http://www.australiancurriculum.edu.au/science/content-structure>

The science content for this particular entry is described in the Australian Curriculum: Science (AC:S), relevant to the year or phase of learning of your students.

<http://www.australiancurriculum.edu.au/science/curriculum/f-10?layout=1>

Although the three strands of the science curriculum are interrelated and are expected to be taught and learnt in an integrated way, this entry focuses on the **Science Inquiry Skills** strand in particular.

<http://www.australiancurriculum.edu.au/science/content-structure> .However, your entry will demonstrate how your teaching links to and makes a contribution to developing *Science Understanding* and *Science as Human Endeavour*.

Note: *Individual jurisdictions may have mandated variants of the AC:S. If so, the relevant curriculum documentation should be referenced.*

<http://www.australiancurriculum.edu.au/science/implications-for-teaching-assessment-and-reporting>

3. Research on effective teaching practice in science

Highly accomplished science teachers keep up with research and best practice in their teaching field. In your entry, you will show how you have drawn on this research and explain how it has informed your approach to teaching and learning in science, particularly in teaching the unit of work featured in this entry, and your approach to developing their skills in science investigation and inquiry.

Requirements for Entry 3: Science Investigation and inquiry

Your film segment, artefacts and written commentary will provide evidence of how you have enabled students to develop, apply and make gains in science investigation and inquiry skills. The evidence for this entry needs to relate to the goals (long and short term) and outcomes intended for the particular investigations and inquiries

Film recording

The class and the film segment, which demonstrates active student engagement with the investigation and inquiry, should be specifically selected to demonstrate your professional knowledge and practice to best advantage. The film should provide evidence of how you interact with your students to collaboratively develop particular aspects of scientific investigation and inquiry skills .

Guidance is provided in the *Supporting information*. [\[link\]](#)

Artefacts

The artefacts you select must support this particular entry. Guidance on selection is provided in the *Supporting information*. [\[link\]](#)

Requirements for assembling, formatting, digitising and submission of items is provided.... [\[link\]](#)

Written commentary

Your written commentary will consist of the following six components:

1. School context

Provide an overall context for the school and the wider community by addressing the points below.

- 1.1 Type of school, its location (rural/remote/urban), jurisdiction (State, Catholic, Independent), Level (e.g. primary, secondary, F-12); single/multi-campus, co-ed/single sex boys/girls [*use drop-down boxes*].
- 1.2 Total school enrolment, year levels, number and size of classes
- 1.3 Mandated curriculum requirements. **Note:** your school/jurisdiction may mandate a variant of the AC:S. Please give relevant details if this is the case.
- 1.4 Demographic composition and characteristics of the school and the wider community, e.g. cultural, ethnic and socio-economic backgrounds, language diversity, composition and integration of students with disabilities.

2. Teaching context

Describe the characteristics of the class you have selected for this entry as well as the resources and other factors that influenced your teaching and learning of this unit of work, including:

- 2.1 The year level, age range and number of students in the class.
- 2.2 The nature of the facilities such as space or resources you have available to teach this class.
- 2.3 The broader resources (including personnel) available that facilitate or limit teaching and learning in science.
- 2.4 Features of school program that affect science teaching to this class.
- 2.5 Particular characteristics of the **class** you that influenced your design of the teaching-learning sequence.

3. Research on effective teaching practice in science

Best practice for teaching science is supported by a large body of educational research literature. This entry needs to include references to the research literature and an explanation of how it has informed your approach to science teaching and learning and, in particular, how it influenced your approach to planning and teaching the unit of work featured in this entry. Select and reference 2-4 authoritative research studies in the field of science teaching and learning that have influenced the way you teach scientific investigation and inquiry skills.

4. Planning

In this section you need to provide an overview of the plan for the unit of work of which the activities featured in your film segment form a part. The purpose of science investigation in which your students will be engaged needs to be described within the context of the overall teaching-learning sequence.

Specifically you are required to describe particular activities that students engaged in that led to the film segment, and also describe activities contained within the film segment that demonstrate how they support achieving the goals. Where appropriate refer to specific artefacts that you are submitting to support this entry Outline the goals for the teaching and learning sequence that is shown in the film.

- 4.1 What were your overall goals for the unit of work? Why were these goals important for your students? What particular challenges are presented by the class you have chosen for this entry?
- 4.2 What was the sequence of learning activities designed to help students achieve those goals? Describe the previous activities the students were engaged in that lead to the activities shown in the film sequence. How were the activities related to the goals.
- 4.3 What specific challenges were involved in implementing these activities with your students?
- 4.4 What resources and strategies did you use to establish a collaborative learning environment in which students could develop their scientific investigation and inquiry skills?

- 4.5 What was your plan for assessing the extent to which your learning goals were being achieved?

5. Analysis

In this section, you will present an analysis of your practice and students' learning in relation to their developing skills in science investigation and inquiry. Your analysis will need to point to specific examples of evidence in the film segment.

Analyse the interactions between you and your students and between students that demonstrate how you facilitated and monitored development of their investigation and inquiry skills in science and deepened their understanding of related scientific concepts. In your analysis, refer to specific interactions, between students and groups of students. Ensure that students remain anonymous. Students can be identified by means such as location, clothing or gender.

The analysis should include:

- 5.1 The reasons you choose this particular film segment to submit.
- 5.2 A description of specific interactions between you and your students and between students that provides evidence of the strategies you employed to assist them in developing particular skills of scientific investigation and inquiry.
- 5.3 Features of the learning environment that enabled your students to participate in the activities collaboratively and purposefully.
- 5.4 An identification of evidence in the film segment that demonstrates learning gains achieved by your students.

6. Reflection and evaluation

In this section, you will reflect on and evaluate the effectiveness of your teaching practice and on student learning outcomes in relation to your goals for the unit of work and in relation to the teaching-learning featured in this entry. Include an evaluation of the impact and implications these outcomes have or may have on your teaching practice, particularly how you follow-up with these students.

Your evaluation should be guided by the questions below. Support your responses by making specific reference to the interactions identified in the film, and to the artefacts associated with the planned and implemented teaching-learning sequence.

- 6.1 To what extent was your knowledge of your students effective in influencing the teaching strategies you used to develop students' skills in science investigation and inquiry?
- 6.2 To what extent did the learning environment enable all students to participate collaboratively?
- 6.3 How effective were the methods you used to monitor the development of students' skills in scientific investigation and inquiry? Include direct reference to the film.
- 6.4 How did the interactions and outcomes of the activities shown in the film, inform your teaching practice with these students subsequently?
- 6.5 Reflect on the extent to which the research you referred to above made a useful contribution to teaching this unit of work.

Entry 3 Secondary Science: Science investigation and inquiry Summary of requirements

Components of the portfolio entry	Limits*	Description	
Film	15-20 min	Continuous and uninterrupted (may be part of a more extensive film). Contains evidence of teacher practice and student engagement in investigations.	
Artefacts	8 pages	Materials created or selected by the teacher to support the teaching and learning practices viewed in the film segment	
School context	1p Not scored	Describes the characteristics of the school and wider community that may influence your teaching practices.	
Teaching context	1p Not scored	Describes the characteristics of students in your class or mediating factors and how they influence your teaching.	
Written commentary <i>Describes, analyses and evaluates a classroom session as part of a unit of work in which you have developed student' investigation and inquiry skills.</i>			Written con
Research on effective teaching practice in science	Reference 2-4 articles 1 page max.	Demonstrates how educational research has informed your practice generally and your approach to developing students' scientific investigation and inquiry skill in particular.	
Planning	3 pages	Describes the plan for the overall teaching/learning sequence of which the film segment forms a part Describes the intention of the particular activities featured in the film segment.	
Analysis	3-4 pages	Points to and analyses evidence in the film segment that student are engaged purposefully in science investigations, developing their inquiry skills and deepening their understanding of important scientific concepts.	
Reflection and evaluation	2 pages	Provides a review the unit of work as a whole, and the film segment in particular, discussing the extent to which it was successful in achieving your goals and its implications for future teaching of inquiry skills.	

While there can be some variation in the length of each section, the total page length should not exceed 12 pages. When completed, each of these components will be uploaded to a website. Guidelines for uploading will be provided later.

Supporting information: guidance for preparing your portfolio entry

How to demonstrate practice to best advantage

Both the class itself and the video segment you choose to submit should provide you with the opportunity to demonstrate your professional knowledge and practice to best advantage.

The film, written commentary and supporting artefacts will constitute the primary evidence. They will demonstrate how you have enabled these students to make gains in developing and applying their science skills of inquiry relevant to the intentions of the particular investigations, the longer term learning goals and the requirements of the portfolio entry.

Selection of the class

It is suggested that the class you select has some experience in scientific investigation and inquiry, though it is not essential.

Selection of the activity

Not all activities students engage in will provide opportunities for you to demonstrate your practice to best advantage. Select an activity or variety of different concurrent activities in your class that will provide plenty of opportunity for you to demonstrate your ability to teach and manage groups as they engage purposefully and collaboratively in scientific inquiry and investigation in meaningful contexts.

The aspect(s) of science investigation and inquiry that is/are being conducted should be clearly evident and identified in the video you submit. You might, for example, choose from an early stage in a particular scientific investigation or inquiry such as in planning an investigation, or during or towards the end of the investigation. You might choose to video different groups that are at different stages in their investigations such as gathering information, evaluating procedures, analysing data or transposing results into visual representations; or in activities that test claims made in the media or elsewhere.

The use of the terms 'Investigation' and 'Inquiry' in this entry is consistent with their usage in the Australian Curriculum – Science¹. In summary, 'Inquiry' here is more to do with process whereas 'Investigation' is more to do with procedure and type of activity.

The lesson should provide the opportunity for you to demonstrate your ability to facilitate the students' engagement in the process of scientific inquiry or investigative procedures rather than on the provision of activities that tend to follow a prescribed procedure, or that focus on interactions solely between students.

Selection of artefacts

The artefacts you select must support this particular entry. Review the questions required to complete the **Written commentary**. These will help guide the choices you make about what to submit in support of your response. Be sure to adhere to the requirements for submission. [\[link...\]](#)

Teaching and student artefacts should not replicate what is evident in the video but could illustrate, for example, your planning, implementation, monitoring or intervention strategies that support the development of skills of scientific inquiry or investigation by these students.

¹ 'Investigation' and 'Inquiry'

<http://www.australiancurriculum.edu.au/science/content-structure>

Taking the film

The technical requirements for the video can be found

If you and your students are unfamiliar with the process of being recorded on video, it is worthwhile recording a number of sessions/lessons during teaching-learning sequence where students are engaged in such activities. Those students who do not have permission to be videoed should be excluded from the class or otherwise be made unidentifiable.

The video could be taken by a colleague or student who is not an active participant in the class. It is advisable that the person has, or comes to have, some familiarity or expertise in taking a video.

The video could show your interaction with different groupings within the class or with the class as a whole. If you record entire lessons it provides the opportunity to make a judicious selection of the required continuous and uninterrupted 15-20 min segment that you will submit. This segment will be the evidence of the quality of your interactions with your students in relation to facilitating the development of their skills of science investigation and inquiry.

In providing analysis of interactions you consider significant, it is advised that the time of the occurrence of the particular interactions, strategies or other features you wish to point out, are provided in your response.

Individual students could be addressed by their first name but must be otherwise anonymous. Students and groups can be identified by a distinguishing feature, such as clothing, numbering or group name; students could have their image made unidentifiable.

Selection of Research findings

For this entry you are expected to source and reference authoritative research that has influenced your science teaching. A comprehensive literature review or analysis is not expected, but you should indicate how your professional reading has informed your teaching practice and your knowledge of students. It should demonstrate how knowledge from literature about science and science teaching has enabled you to keep your teaching practice current.

The reading should be cited in your writing and referenced appropriately. This enables assessors to identify what has influenced and informed your teaching practice in relation to facilitating whole-class discussion to developing students' collaborative science inquiry and investigation skills.