DEPARTMENT OF EDUCATION
learners first

Transdisciplinary Science 2

Course Implementation Guide

Transdisciplinary Projects

SCIENCE

Catholic Education Tasmania

INDEPENDENT SCHOOLS TASMANIA

Years 9 - 12 Learning

Tasmanian Government

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Course Implementation Guide
Transdisciplinary Science (TDS215122)

About this document

This course implementation guide supports the course document[1]. It supports teachers to create active and engaging learning experiences.

The Department of Education's A Pedagogical Framework has informed this resource.

Focus area support

This is a transdisciplinary projects course.

Transdisciplinary Science 2 gives learners the opportunity to inquire deeply into an application of science that is valued in Tasmania. The choice of possible focuses is to be outlined and negotiated between teachers and learners. There will need to be processes in place to ensure that the inquiry is achievable.

Teachers will support learners to engage with and practice processes that underpin scientific inquiry, including data collection and connections with local, national and global science. Teachers should guide learners, gradually releasing responsibility for monitoring and progress as learners make their own connections and apply the science for themselves.

Teachers will support learners to build on the critical thinking skills as they represent, reorganise and draw conclusions from data collected. Learners will utilise and build on their scientific knowledge to consider, analyse and refine their inquiry. A coherent presentation of the whole inquiry will need to occur by the end of the course.

Localisation and customisation

Localisation

- Learners, within the constraints of what is possible on individual sites, will be increasingly responsible for their inquiry and progress.
- All providers should have access to replicable Tasmanian examples of scientific study wherever they are situated.
- If delivered remotely, this course would need local support for learners to conduct their inquiry.
- Implementation of this course could occur alongside the proposed Transdisciplinary Science 3 course.

Customisation

Opportunities exist to customise learning and content throughout the course. Examples of this include:

- providers should guide the broad focused that are possible within their context, considering the resources and expertise available.

[1] A 'course document' refers to accredited course information on the TASC website.

- Tasmanian applications of science and learners engaging with them is central to this course.
- choosing a range of modes and methods to gather evidence of understanding for depth of engagement and replication of scientific practice.
- as they progress learners will differentiate their own work through self and peer assessment and discussion.
- longitudinal scientific inquiry and the associated evidence of learning are ideally suited to delivery and management online.

Course delivery advice

Module	Subtopic	Indicative Times
Module 1 – Research, trial and plan	Research and trial	30 hours - weighted towards the beginning of the Module
	Planning	20 hours - weighted towards the end of the Module
Module 2 – Conduct, monitor and refine	Researching and refining context	10 hours – throughout module
	Researching and refining scientific knowledge and methodologies	10 hours – throughout module
	Conducting and refining inquiry design	30 hours – throughout module
Module 3 – Review, represent and recommend	Finalise collection of evidence from Module 2	First 20 hours
	Analysis and presentation of inquiry	Final 30 Hours

Teaching and learning

Module 1: Research, trial and plan

The following learning outcomes are a focus for this module:

1. collaborate with others and monitor, reflect on, and manage their learning within a scientific inquiry
2. plan, collect and analyse data within a specific application of science to inquire into a system
3. apply concepts and processes from selected scientific theories and models to inquire into a system
4. communicate data and information using standard scientific conventions for qualitative and quantitative representation and comment on its reliability
5. explain the context of their inquiry locally, nationally and globally and relationships between technology, science and the broader community for a particular scientific application
6. apply information they have researched to implement processes and trial methodologies while inquiring into a system.

Module 1: Teaching strategies

In this course, where responsibility for learning is gradually released, teachers will need to be explicit. Learners will need to have clear parameters of what scientific focuses can be investigated and the resources available. This this will enable all learners understand the intention and goals of all tasks they complete. This will also prepare them for the inquiry they will be responsible for in the rest of the course.

Teachers can use the Inquiry Project Approval Procedures to set road-markers for learners. This will support them to assess their and their peers' progress. The structure of the logbook should support learners to record and organise their knowledge, skills and reflections. Allowing them to track their progress in a way that is accessible. The first point where the learners will have to access their own work in-depth will be the Research and Plan Work Requirement at the end of the module.

The use of a digital logbook to aid in continual self, peer and teacher assessment is recommended. In addition, a digital logbook provides a flexible means for learners to document and access what they have found. Learners will need significant guidance throughout this module on how to use the folio. This should include regular structured time to complete and reflect on their progress, including self and peer assessment.

While the learners are exploring the Tasmanian context and possible focuses for their inquiry it is appropriate to begin with a structured common inquiry. This will help with understanding of inquiry processes and offers opportunities for teaching the required skills and habits.

Module 1: Examples of learning activities

The why for learners

These activities describe how to help learners set goals and make connections:

- Learners spend time exploring observable phenomena on a field trip. Once they have made their observations ask them to brainstorm explaining what can be measured about what they have observed. Use their ideas to illustrate the transdisciplinary nature of science.
- Share with learners some applications of science in Tasmania. Discuss the range of sciences used within each application. Ask the learners to identify three applications that they might find interesting. Learners can then generate questions they have about one of these.
- Organise a class discussion with a scientist to discuss how they work to further the understanding in their field, the science that it relates to and the equipment they use. Learners reflect on what they might want to know more about in the scientist's field of study.

The what for learners

These activities describe how to help learners to grasp big ideas and key understandings, make links to prior learning and organise new information:

- Learners undertake a short, structured inquiry related to a provider supported focus. Learners step though the inquiry process and how to use the structure of the logbook to aid in recording and reflecting on data and information and creating science-based explanations.
- Learners research the problems for Tasmania scientists are helping to solve related to their area of study. Use this information to narrow the possible inquiry questions for each learner.
- Learners choose from a provided range of focuses and are given a list of scientific applications conducted in Tasmania related to that focus. Learners can then research two or three applications to further understand the science involved and how its applied.

The how for learners

These activities describe how to support learners to create, transfer and deepen knowledge and understanding:

- Learners trial simple methodologies to investigate their possible inquiry question using a set of resources common to all the class. Using these trials and the links with the scientific understanding learners can start to plan their inquiry.
- Where appropriate learners reference First Nations Tasmanians' knowledge which can aid in understanding the context for their possible inquiry. This knowledge may be useful for the context or scientific understanding of the systems investigated.
- Learners experiment with different ways to represent their data and information. What variables can they measure? What might it tell them? Which are the dependent and independent variables? How are they related? How do they relate to the possible inquiry questions?
- Learners plan a rough set of investigations for their inquiry and share it with their peers for feedback. Once this feedback has been addressed, the teacher can assist and support the learner to develop a risk management plan. The learner can then consult with the laboratory manager.

Module 1: Focus area guidance

Engage and ideate

- Learners, using their prior knowledge, will engage with and ideate a focus of inquiry that is relevant to our community.
- Learners will discover that in practice science draws from many scientific disciplines.
- The emphasis will be on the Tasmanian context with some links to national and global context only where appropriate or useful.

Connect and apply

- By researching, connecting and iteratively inquiring into this focus learners will begin to understand its general place in Tasmania, nationally and globally, and explore the theories, models and methodologies that are key to creating knowledge.
- The application of science through inquiry, reflection and refinement of understanding at every stage is key to this module.
- Learners should prepare to question their work and return to earlier work to ensure they build their knowledge.

Exhibit and reflect

- In this module, trialling processes and methodologies is crucial to prepare for further inquiry.
- Through this process possible lines of inquiry will emerge to be further refined in Module 2. Learners will have the opportunity to demonstrate their findings and plans through a folio
- Learners will then analyse their understanding and experience to choose a focus, and plan, for further investigation in Module 2.

Module 1: Recommended resources

- Providers offering this course will need equipment, materials and a suitable space to carry out the practical component of the course effectively and safely.
- Communities of Practice may provide additional resources.
- Tasmanian Field Study Centres: Field Study Centres - The Department of Education Tasmania
- Aboriginal Education Services (Aboriginal Education Services, 2021).
- Motivation and ideas for inquiry can be generated through the 2030 Sustainable Development Goals (United Nations, 2021).
- Tasmanian Field Study Centres: Field Study Centres - The Department of Education Tasmania
- Effect of Inquiry based Learning Method on Students' Motivation (Bayram & al, 2013).
- Inquiry-based learning (Department of Education, Skills and Employement, 2021).
- Enquiry-based learning (Griffth University, 2021).
- Teachers' roles and identities in student-centered classrooms (Keiler, 2018).
- Assessment in inquiry based learning (OPHEA, 2021).
- 5 Ways to Get the Most Out of Student Portfolios (Spencer, 2020).
- Discover, Discuss, Demonstrate: Using Inquiry-Based Learning to Keep Students Engaged (Stephanie Rothstein, 2021).

Module 2: Conduct monitor and refine

The following learning outcomes are a focus of this module:

1. collaborate with others and monitor, reflect on and manage their learning within a scientific inquiry
2. plan, collect and analyse data within a specific application of science to inquire into a system
3. apply concepts and processes from selected scientific theories and models to inquire into a system
4. communicate data and information using standard scientific conventions for qualitative and quantitative representation and comment on its reliability
5. explain the context of their inquiry locally, nationally and globally and relationships between technology, science and the broader community for a particular scientific application
7. modify and finalise experimental design for an inquiry as they collect and analyse data, undertake further research, and monitor their progress.

Module 2: Teaching strategies

Teachers will need to rely on the established skills, knowledge, processes, and planning developed in the first module. Learners will have much more responsibility for monitoring and maintaining their own progress. Teachers will ensure that learners are able to continue with an achievable inquiry making suggestions for guidance where necessary.

Regular structured time will have to set aside for learners to add to and reflect on the understanding of science and methodologies that underpin their inquiry. These processes should follow those set up in the first module. Incorporate ongoing self, peer and teacher assessment to maintain progress and continual reflection.

Teachers will support learners as they refine their inquiry question with reference to the methodologies and scientific understanding. This should become more targeted to support the learners' investigation. A shared digital logbook is useful to track and support learners' progress with comments, questions, or suggestions.

Scaffold expectations by using the Conduct, Monitor and Refine Work Requirement. While preparing for this Work Requirement, learners can experiment with different methods of presenting the data and information they have generated to best represent the progress of their inquiry. This will be useful for reflecting on their progress and preparing them for the final module.

Module 2: Examples of learning activities

The why for learners

These activities describe how to help learners set goals and make connections:

- Learners continue to investigate the importance of the science related to their inquiry for Tasmania and the issues that accompany it. Through this process they can start to refine the context and make connections with similar science and issues nationally and globally.
- Learners continue to research the scientific understanding that underpins their inquiry. Making new connections and recording any questions that may arise. What further understanding do I need? Are there any other studies that could help the inquiry?
- Learners share their plans with others in the class with similar inquiry questions or processes. Through Module 2 they can discuss their progress and what they have learnt about all aspects of their inquiry to suggest refinements to each other.

The what for learners

These activities describe how to help learners to grasp big ideas and key understandings, make links to prior learning and organise new information:

- as learners collect and reflect on their data. They can identify future refinements to their knowledge and practice. Are there gaps on the data? Are there some unexpected results? How can these be explained? What changes to the methodologies could assist?
- Connect learners, in-person or online, to a scientist or other expert working in a similar area. The learners can, in dialogue, learn more about what is important as they refine their inquiry question.
- Learners make as detailed observations as possible in relation to the collection of data. This may include video or photographic evidence. Use this to explain data collected in comparison to what would happen if the scientific model represented the system perfectly.

The how for learners

These activities describe how to support learners to create, transfer and deepen knowledge and understanding:

- Learners refine the ways to represent the data and information they have generated to demonstrate what they have found and what still needs further investigation. If using a spreadsheet to assist include this new data as it is generated for interpretation.
- Learners refine their scientific understanding to explain the data as they collect it. They use their logbook to reflect on what scientific understanding is most suited to explaining their findings while other explanations are less relevant.

- Learners use the refinement processes to plan for the collection of the last sets of data in the next module. What is the purpose of these processes? Is it gaps in the data? Is it to confirm their current dataset? Has something else emerged that needs testing in relation to the finalised inquiry question?

Module 2: Focus area guidance

Engage and ideate

- As the inquiry progresses, monitor and refine all aspects.
- This module provides an opportunity for the learner to engage more deeply with the focus of inquiry.
- Learners will finalise their inquiry question and the processes used to pursue it. They will do this through further targeted research, reflection, and investigation into this focus

Connect and apply

- By applying theories, models and methodologies they will be able to refine the connections they have already made to support their extended inquiry.
- The application of science through inquiry, reflection and refinement of understanding at every stage is key to this module.
- Learners should always question their work and return to earlier work to ensure they are able to build their knowledge and narrow the focus of the inquiry.

Exhibit and reflect

- In this module, trialling processes and methodologies is crucial to prepare for further inquiry.
- Through this process possible lines of inquiry will emerge to be further refined in Module 2. Learners will have the opportunity to demonstrate their findings and plans through a folio
- Learners will then analyse their understanding and experience to choose a focus, and plan, for further investigation in Module 2.

Module 2: Recommended resources

- Providers offering this course will need equipment, materials and a suitable space to carry out the practical component of the course effectively and safely.
- Communities of Practice may provide additional resources.
- Tasmanian Field Study Centres: Field Study Centres - The Department of Education Tasmania
- Aboriginal Education Services (Aboriginal Education Services, 2021).
- Tasmanian Field Study Centres: Field Study Centres - The Department of Education Tasmania
- Effect of Inquiry based Learning Method on Students' Motivation (Bayram & al, 2013).
- Inquiry-based learning (Department of Education, Skills and Employement, 2021).
- Enquiry-based learning (Griffth University, 2021).
- Teachers' roles and identities in student-centered classrooms (Keiler, 2018).
- Assessment in inquiry based learning (OPHEA, 2021).
- 5 Ways to Get the Most Out of Student Portfolios (Spencer, 2020).

- Discover, Discuss, Demonstrate: Using Inquiry-Based Learning to Keep Students Engaged (Stephanie Rothstein, 2021).

Module 3: Review, represent and recommend

The following learning outcomes are a focus of this module:

1. collaborate with others and monitor, reflect on and manage their learning within a scientific inquiry
2. plan, collect and analyse data within a specific application of science to inquire into a system
3. apply concepts and processes from selected scientific theories and models to inquire into a system
4. communicate data and information using standard scientific conventions for qualitative and quantitative representation and comment on its reliability
5. explain the context of their inquiry locally, nationally and globally and relationships between technology, science and the broader community for a particular scientific application
8. use science inquiry skills to assess and represent the key data and findings from an extended inquiry into systems and make recommendations for further study.

Module 3: Teaching strategies

Above all, the focus of this module is on analysis and representation of understanding. It will take time to for learners to make connections between all aspects of their inquiry. Practical work designed and undertaken should finalise answering the inquiry question from the earlier module.

Use the specifications for the folio and presentation Work Requirements to plan for explicit teaching and provide checkpoints for learners to assess their progress. Teachers should encourage learners to focus their time on the more challenging aspects of these Work Requirements. These include:

- summarising, representing and interpreting data from the inquiry
- analysis leading to conclusions
- suggestions for further investigation.

The creation of a formal scientific paper and a poster will require some explicit teaching and monitoring. Use the regular processes established earlier in the course and the logbook to document progress and self-reflection. Provide opportunities for peer and teacher comments and suggestions.

Communicating understanding is more important than meeting a word count. The scientific paper can be in any mode or modes that convey the information needed. Where appropriate encourage learners to use accepted scientific formats in place of words. For example:

- diagrams
- data tables
- graphs
- statistical analysis
- algebraic modelling.

The poster should include concise, large font, statements to assist others with interpreting the diagrams, charts and images and other visual representations rather than large blocks of text.

Module 3: Examples of learning activities

The why for learners

These activities describe how to help learners set goals and make connections:

- Using feedback from presenting the quad chart at the end of the earlier module learners can reflect on how to represent what they have found to date more effectively. What needs to be done to provide clear evidence and explanations?
- Learners begin to review the work they have recorded in their logbook together with their own, peer and teacher reflections to make further possible connections. Is there something that makes sense now that didn't before or something that you may have missed?
- Learners plan their time for the remainder of the module to ensure that they have time to work through any areas of need within their inquiry. For example, finalising their overall data analysis to make reasoned evidence-based conclusions.

The what for learners

These activities describe how to help learners to grasp big ideas and key understandings, make links to prior learning and organise new information:

- As learners complete their final data collection, they assess the data to see where it fits within the inquiry. Is this data collection serving the intended purpose or is it posing more questions? What might need to go into possible further investigations in the paper?
- What scientific knowledge and models describe what learners have found? How are these best represented? With a diagram, a series of images or another representation? How can the connections between the inquiry and science be explained?
- Learners review their data and information for any limitations that may have affected the inquiry overall. Were they unavoidable in the inquiry (for example, limitations in accuracy of measuring equipment)? Could they be avoided in a future investigation?

The how for learners

These activities describe how to support learners to create, transfer and deepen knowledge and understanding:

- Challenge learners to create a coherent scientific paper that only includes the most important data and information without ignoring important parts of the inquiry. The paper needs to allow others to understand what has been found and replicated in the inquiry.
- Challenge learners to create a poster that contains the essence of the inquiry and what it has found without an overload of information. There should be enough information for people to understand what you have found and why to ask relevant questions.
- Encourage learners to use each other, their teacher and any other person that may be able help in completing this module. This is particularly important for the presentation of the poster. Practise this presentation with trusted others before assessment.

Module 3: Focus area guidance

Engage and ideate

- Scientific inquiry requires significant time to reflect, analyse, communicate and recommend.

- Module 3 of Transdisciplinary Science Level 2 provides an opportunity to finalise data collection and focus on completing the inquiry.
- By engaging with this module learners can complete any further investigation or research required to support answering their inquiry question.

Connect and apply

- By applying only the most relevant theories, models and methodologies, they will be able to make the connections required to develop valid and supported conclusions.
- As with earlier modules, specific application of science through inquiry, reflection and refinement of understanding at every stage is key.

Exhibit and reflect

- At this stage learners should do this to ensure that their analysis, communication and presentation reflects their inquiry question.
- Through this process possible answers emerge for discussion and will be finalised. Learners will demonstrate their findings through a folio, a poster and a presentation.

Module 3: Recommended resources

- Providers offering this course will need equipment, materials and a suitable space to carry out the practical component of the course effectively and safely.
- Communities of Practice may provide additional resources.
- Tasmanian Field Study Centres: Field Study Centres - The Department of Education Tasmania
- Aboriginal Education Services (Aboriginal Education Services, 2021).
- Tasmanian Field Study Centres: Field Study Centres - The Department of Education Tasmania
- Effect of Inquiry based Learning Method on Students' Motivation (Bayram & al, 2013).
- Inquiry-based learning (Department of Education, Skills and Employement, 2021).
- Enquiry-based learning (Griffth University, 2021).
- Teachers' roles and identities in student-centered classrooms (Keiler, 2018).
- Assessment in inquiry based learning (OPHEA, 2021).
- 5 Ways to Get the Most Out of Student Portfolios (Spencer, 2020).
- Discover, Discuss, Demonstrate: Using Inquiry-Based Learning to Keep Students Engaged (Stephanie Rothstein, 2021).

Supporting learner responses

The work requirements outlined in the course document describe the fundamental assessment evidence. Inclusion of other tasks may support and enhance learning. Learning activities aim to support and enrich understanding and achievement of the learning outcomes. Possible strategies to support learner responses to work requirements are provided.

Module 1: Research and plan

Context

In this unit, learners have explored inquiry processes with a particular focus on what is required to plan a scientific inquiry for a period of 8 weeks. Additionally, they may have undertaken/participated in excursions, incursions or expert discussions.

This work requirement for the research outline allows the learner to demonstrate that they have an achievable plan to complete a transdisciplinary science inquiry within the scope of this course. The design of the content and logbook for this module lead learners to this point.

Relevant learning outcomes

2. plan, collect and analyse data within a specific application of science to inquire into a system
3. apply concepts and processes from selected scientific theories and models to inquire into a system
4. communicate data and information using standard scientific conventions for qualitative and quantitative representation and comment on its reliability
5. explain the context of their inquiry locally, nationally and globally and relationships between technology, science and the broader community for a particular scientific application
6. apply information they have researched to implement processes and trial methodologies while inquiring into a system.

Scaffolding

- This Work Requirement provides the main evidence needed to meet the Inquiry Project Approval Procedures.
- The structure of the logbook should support this Work Requirement (and Work Requirements for future modules).
- Learners should practise, trial and generate evidence to complete this task. Documenting what they have learnt so far and their plans for their inquiry.
- Teaching of how to represent this information will be required to support learners.
- Regular self, peer and teacher reflection during this initial module will prepare learners to complete this task.
- Although a word limit is specified, encourage learners to use other accepted scientific representations in place of words where appropriate.
- The annotated bibliography is only required for the most important sources of information.

Module 2: Logbook (folio)

Context

The logbook is a record of observations, data, reflection and learning for the entire module. In this module the learner is taking greater responsibility for their learning with the logbook as the central record. Create the logbook in an exercise book, a loose-leaf folder, or an online platform such as OneNote. A digital record

makes it easier to record, organise and access ongoing work as well as facilitating self, peer and teacher reflection.

Relevant learning outcomes

1. collaborate with others and monitor, reflect on, and manage their learning within a scientific inquiry
2. plan, collect and analyse data within a specific application of science to inquire into a system
3. apply concepts and processes from selected scientific theories and models to inquire into a system
4. communicate data and information using standard scientific conventions for qualitative and quantitative representation and comment on its reliability.

Scaffolding

- In this module learners, although supported, have much greater responsibility for their learning – scaffolding should guide learners and provide opportunities for reflection.
- The logbook should have sections that support the learners to record, reflect on, and reorganise their work with sections such as:
  - planning
  - monthly log
  - running annotated bibliography
  - research notes
  - observations and data
  - emerging relationships
  - reflection and evaluation
  - log of time on task
  - peer and self-assessment
  - teacher feedback.
- Learners should have in mind that they need to finalise their inquiry question and have largely completed collecting data by the end of the module.
- Provide regular opportunities for learners to reorganise their work.
- Schedule regular self, peer and teacher review to ensure learners are progressing well.
- Regular opportunities to refine the contextual information and the supporting scientific models and theories are essential.

Module 3: Review, represent and recommend – presentation

Context

In this unit, learners have explored finalising their inquiry with a particular focus on completing outstanding data collection for a period of 4 weeks. Together with the authoring of a scientific paper the poster will require the remaining 7 weeks of the module.

This presentation work requirement allows the learner to replicate the common process of a poster presentation accompanied with follow-up questions. The poster should represent the major evidence and findings of the inquiry without an overload of information.

Relevant learning outcomes

4. communicate data and information using standard scientific conventions for qualitative and quantitative representation and comment on its reliability
5. explain the context of their inquiry locally, nationally and globally and relationships between technology, science and the broader community for a particular scientific application
8. use science inquiry skills to assess and represent the key data and findings from an extended inquiry into systems and make recommendations for further study.

Scaffolding

- Learners will need explicit guidance for producing the poster.
- Above all, the poster and presentation are a celebration of what learners have achieved in the year.
- Learners need to convey the major evidence and the outcome of their analysis for the poster.
- Text should be concise and in large font.
- Diagrams, charts, and images should convey the bulk of the data and information.
- The format of asking questions allows learners to demonstrate the depth and extent of their learning.
- Question learners to discern what they understand rather than gaps in their knowledge and skills.
- The presentation of the poster is an ideal time for learners to demonstrate their own participation and collaboration with others.
- Teachers, and peers, should ask questions about the presentation and meaning of information and data.

Additional support resources[2]

- Course Document
- Sample Scope and Sequence
- Community of Practice

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