Earth and Environmental Science Module 7

# Mangroves and rising sea-level

The following articles and videos are related to a study published in Nature, Lovelock *et al.* (2015) which explores the vulnerability of Indo-Pacific mangrove forests to sea-level rise.

## Initial Study and related media

**Original Nature article**

Lovelock, C., Cahoon, D., Friess, D. *et al.* [The vulnerability of Indo-Pacific mangrove forests to sea-level rise.](https://doi.org/10.1038/nature15538) Nature **526,**559–563 (2015). Available as a free download: [The vulnerability of Indo-Pacific mangrove forests to sea-level rise](https://digitalcommons.unl.edu/usgsstaffpub/988/)

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**Article from The Conversation**

Saintilan, N., Lovelock, C., Rogers, K. (2015) [Rising seas threaten to drown important mangrove forests, unless we intervene.](https://theconversation.com/rising-seas-threaten-to-drown-important-mangrove-forests-unless-we-intervene-49146) **The Conversation Media Group Ltd; VIC.**

**Video embedded in The Conversation article showing equipment use**

User: UQx Tropic101x Tropical Coastal Ecosystems (2014) [*Sediment Elevation Tables Ruth*.](https://www.youtube.com/watch?v=8shYRprgTE4) (duration 3:23) YouTube.com

**Video narration of main points from Nature article, embedded in The Conversation article**

User: Maya Reef (2015) [RSET\_Publication\_Vid*eo*.](https://www.youtube.com/watch?v=ya3EI7Yknf4&feature=emb_title) (duration 8:55) Youtube.com.

## Working Scientifically Skills

In the [Earth and Environmental Science Syllabus](https://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/stage-6-learning-areas/stage-6-science/earth-and-environmental-science-2017) are the Working Scientifically Skills outcomes and content. In the following activities and task you need to analyse how the Working Scientifically Skills were utilised in a published research study. The skills of scientific investigations and the working scientifically skills content of the syllabus may be applied to non-familiar areas and may be examined in the HSC examination. For example:

Analyse the use of working scientifically skills in **both** investigating major anthropogenic environmental problems facing Australia **and** developing management strategies to minimise the effects of these problems. Use examples to support your answer.

2019 HSC Earth and Environmental Science Examination Question 35 (9 marks)

Outcomes and Syllabus content in this document is from [Earth and Environmental Science Stage 6 Syllabus](https://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/stage-6-learning-areas/stage-6-science/earth-and-environmental-science-2017) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales.

## Working Scientifically Skills outcomes and content

### Questioning and predicting

#### Outcome:

* develops and evaluate questions and hypotheses for scientific investigation

#### Content:

* develop and evaluate inquiry questions and hypotheses to identify a concept that can be investigated scientifically, involving primary and secondary data
* modify questions and hypotheses to reflect new evidence

### Planning investigations

#### Outcome:

* designs and evaluates investigations in order to obtain primary and secondary data and information

#### Content:

* assess risks, consider ethical issues and select appropriate materials and technologies when designing and planning an investigation
* justify and evaluate the use of variables and experimental controls to ensure that a valid procedure is developed that allows for the reliable collection of data
* evaluate and modify an investigation in response to new evidence

### Conducting investigations

#### Outcome:

* conducts investigation to collect valid and reliable primary and secondary data and information

#### Content:

* employ and evaluate safe work practices and manage risks
* use appropriate technologies to ensure and evaluate accuracy
* select and extract information from a wide range of reliable secondary sources and acknowledge them using an accepted referencing style

### Processing data and information

#### Outcome:

* selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media

#### Content:

* select qualitative and quantitative data and information and represent them using a range of formats, digital technologies and appropriate media
* apply quantitative processes where appropriate
* evaluate and improve the quality of data

### Analysing data and information

#### Outcome:

* analyses and evaluates primary and secondary data and information

#### Content:

* derive trends, patterns and relationships in data and information
* assess error, uncertainty and limitations in data
* assess the relevance, accuracy, validity and reliability of primary and secondary data and suggest improvements to investigations

### Problem solving

#### Outcome:

* solves scientific problems using primary and secondary data, critical thinking skills and scientific processes

#### Content:

* use modelling (including mathematical examples) to explain phenomena, make predictions and solve problems using evidence from primary and secondary sources
* use scientific evidence and critical thinking skills to solve problems

### Communicating

#### Outcome:

* develops communicates scientific understanding using scientific language and terminology for a specific audience or purpose

#### Content:

* select and use suitable forms of digital, visual, written and/or oral forms of communication
* select and apply appropriate scientific notations, nomenclature and scientific language to communicate in a variety of contexts
* construct evidence-based arguments and engage in peer feedback to evaluate an argument or conclusion

## Student Activities

In this collaborative activity, you will be asked to compare the way scientific information is communicated through different media.

### Lesson 1:

In pairs, one person is to view the article from The Conversation and the embedded video files, whilst the other is to read the Nature research article. Re-read and as you progress, summarise the main points under the headings:

* Questioning and making the hypothesis
* Planning and conducting the investigation
* Data collection and representation of data
* Analysis of data
* Problem solving and critical thinking: predictions and the limitations of modelling
* Making Conclusions
* Communication of the research study using the article

### Lesson 2:

* Pairs share and describe to the other, in 5 minutes each, a summary of the main points of the article they have viewed.
* Pairs now swap over and view the other source, adding to their existing summary as necessary.
* Pairs come back together and discuss the following:
  + What features are very different between the two articles?
  + Considering the audience for each, describe how the research was communicated effectively
  + Discuss the need for peer-reviewed scientific papers to be published in reputable journals

## Student Task

In this task students will analyse how the following Working Scientifically Skills were utilised by Lovelock et al. in their study, The vulnerability of Indo-Pacific mangrove forests to sea-level rise. These questions are based on the original Nature article, although the other sources linked to this task may help with answers. The task may be completed after the activities that produced a summary of the articles or as a stand-alone task. The teacher may allocate one, some or all questions, depending on the focus of the lesson.

1. Questioning and predicting
   1. Outline the observations made that identified the need for this study.
   2. Identify the inquiry question made by the researchers. Write a suitable hypothesis for this investigation.
2. Planning investigations
   1. Outline the operation and function of the technologies that were used and explain why they would have been chosen by the researchers.
   2. Identify the independent, dependent and controlled variables of this investigation.
   3. Was the investigation modified at all in response to new evidence and data? Explain.
3. Conducting investigations
   1. Design a risk assessment that may have been conducted prior to the investigation.
   2. Assess the effectiveness of the technologies used to ensure accuracy in the investigation.
   3. Assess the range and validity of sources cited in this investigation (this can be done by browsing the reference list, you don’t have to find or read the sources).
4. Processing data and information
   1. Justify the suitability of the types of graphs (Figure 3 and Figure 4) used in the Nature article.
   2. Identify the qualitative data used, the range of magnitudes in the results and the units of measurements of the variables.
   3. Evaluate ways by which the quality of data might be improved.
5. Analysing data and information
   1. Outline the trends in the graphs (Figure 3 and Figure 4) used in the Nature article.
   2. Assess any errors, uncertainties or limitations in the data.
   3. Assess the relevance, accuracy, validity and reliability of the data and suggest improvements to investigations.
6. Problem solving
   1. Outline the predictions that can be made based on the conclusions of this investigation.
   2. Critical thinking in science involves objective analysis and evaluation of an issue in order to form a judgement. Outline how critical thinking can be used to solve problems identified by this study.
7. Communicating
   1. Justify the suitability of each of the four figures used in the report.
   2. Justify the decision by C. Lovelock, lead author, to release the media article in addition to a research paper
   3. Write a suitable conclusion for this investigation. What further investigations can be undertaken based on this conclusion?

## Marking Criteria

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| --- | --- | --- | --- |
| Working Scientifically Skill | Band 6 Performance band descriptors and indicators (5 marks) | Mark  Awarded  1-5 | Band 2 Performance band descriptors and indicators (1 mark) |
| Questioning and predicting | designs solutions to scientific problems, questions, or hypotheses |  | identifies observations that could lead to investigation  identifies a problem, question or hypothesis that could be investigated |
| Planning investigations | designs and plans investigations to obtain accurate, reliable, valid and relevant primary and secondary data and making modifications in response to new evidence |  | Identifies variable/s that are measured  partially outlines investigations to obtain data and information |
| Conducting investigation | evaluates risks, mitigating where applicable  designs solutions to scientific problems using selected accurate, reliable, valid, and relevant primary and secondary data, and scientific evidence, by applying processes, modelling and formats  reflects and assesses the accuracy and validity of the data |  | identifies risks or hazards  Identifies a technology that may be used in investigations  collects some data and/or information from primary and secondary sources |
| Processing data | selects, processes, and interprets accurate, reliable, valid, and relevant qualitative and quantitative, primary or secondary data  evaluates the quality of the data and the representation |  | identifies methods to organise data  identifies a feature of the data |
| Analysing data | represents data using a range of scientific formats to derive trends, show patterns and relationships, explain phenomena, and make predictions  assess any errors, uncertainties, relevance, accuracy, validity and reliability and limitations of the data and suggest improvements to investigations |  | organises data  recalls basic scientific knowledge and information  identifies features or limitations of the data |
| Problem Solving and Models | designs solutions to scientific problems using scientific evidence by applying processes, modelling and formats  applies knowledge and information to unfamiliar situations to propose comprehensive solutions or explanations for scientific issues or scenarios |  | provides simple description of scientific phenomena or recalls basic scientific knowledge and information  identifies a prediction |
| Communicating | communicates scientific understanding succinctly, logically, and consistently using correct and precise scientific terms and application of nomenclature in a variety of formats and wide range of contexts |  | Identifies a conclusion  communicates scientific understanding using limited scientific terms  recalls basic scientific knowledge and information |