**Maria James:** Hello and welcome to this presentation to support the implementation of Units 1 and 2 of the new study design for VCE Environmental Science. A special welcome to those of you who are new to teaching Units 1 and 2. My name is Maria James, and I'm the VCAA Science Curriculum Manager. I'm delighted today to discuss how the flexibility provided by the content of Units 1 and 2 will enable you to deliver a teaching, learning, and assessment programme that is customised to the needs of your school and to your students.

I'd like to begin by acknowledging the traditional custodians of the many lands across Victoria on which we are all living, learning, and working from today. Working from Fairhaven, I acknowledge the Eastern Maar Peoples as the traditional custodians of the land. I would like to pay my respects to Elders past, present, and emerging, for they hold the memories, traditions, culture, and hopes of all Aboriginal and Torres Strait Islander Peoples across the nation, and hope they will walk with us on our journey.

The purpose of this presentation is to support you in delivering Units 1 and 2 of the new study design. The main focus will be to look at the content in Units 1 and 2 in some detail, particularly in thinking about relevant contexts that you could use with your classes. We will explore how the key science skills can be linked to the key knowledge. We will also look at the methodologies and methods that can be used in environmental science to support your students' learning. I'll then discuss how you can develop assessment tasks that comply with the VCE assessment principles.

You can see from the unit and area of study titles that scientific inquiry is important in Environmental Science. As well as these overarching questions, students can explore their own questions of interest.

Unit 1 looks at the interconnections between Earth's systems while Unit 2 looks at pollution and food and water security. There is flexibility in delivering Unit 1 and 2 in reverse order and in the rearrangement of areas of study within each unit. Generally, schools teach Unit 1 before Unit 2 to make the most of the summer and autumn weather to support field work relating to local and regional ecosystems.

We know that each school is different, and that students have different strengths, talents, resources, and background experiences. Therefore, schools have flexibility in designing curriculum and assessment programmes that meet the needs and resources of their students. All programmes, however, must be aligned with the VCE Environmental Science Study Design and the VCE assessment principles.

One of the most important decisions that you'll need to make relates to the level of student agency and choice. For new teachers of Environmental Science, it might be easier for you to initially narrow choice for students and provide one case study to introduce concepts and skills. You could then allow some degree of student choice for them to look at these ideas in more depth. For those of you who are more experienced in teaching Environmental Science, you might provide a brief introductory overview to a topic or theme, and then allow students to self-select topics. You could also provide students with a set of options from which they could choose. Usually, this approach would involve you providing a set of scaffolded questions to which students respond that cover the outcome, key knowledge, and relevant key science skills.

How key science skills and the eight methodologies are taught across Units 1 and 2 is up to you to decide. You may work with other teachers to develop your programmes with modifications to suit your own school needs. Although local contexts are favoured, students also refer to national and international contexts.

Let's look at some of the main components of the study design that you'll need to consider in developing your teaching and assessment programme.

Whether you are new or experienced as a teacher, you need to think about how you will integrate the key science skills into key knowledge in developing your teaching and assessment programme. Each of these seven general skills are unpacked further on pages seven to nine of the study design and should be taught across Units 1 and 2.

You can apply the key science skills to suit your programme. For example, sampling techniques may apply in looking at ecological relationships in Unit 1 Area of Study 1.

Sampling techniques could also apply to the Unit 1 Area of Study 3 student investigation. It is up to you to work out what skill you want to teach in association with which key knowledge across Units 1 and 2.

Scientific investigations involve students asking questions, testing ideas, and using evidence. Nine methodologies have been outlined in the study design and students should have experience of each methodology across Units 1 and 2. Examples of learning activities involving each of these methodologies are included in the support materials for teachers on the VCAA website.

Some examples of how the nine scientific methodologies may be applied to VCE Environmental Science are shown in the table. Planning your teaching and learning sequence should include opportunities for students to apply these methodologies to their own investigations. You can see that some of these methodologies are not standalone. For example, the classification and identification task of using keys to identify macroinvertebrates as indicators of river health could also form part of fieldwork. A literature review may precede a student's investigations which may include the use of a controlled experiment.

There has been a slight increase in the hours allocated to practical work as shown in this slide. You should note that practical work is not limited to laboratory experiments. Examples of learning activities involving practical work will be provided in the support materials on the VCAA website.

Fieldwork is an important part of practical work in VCE Environmental Science. The VCAA does not specify any particular fieldwork techniques. The ones listed in the table are commonly used in schools. If using local or state parks, regulations regarding activities and the collection of biotic and abiotic materials need to be checked and followed. If you're planning a visit to a commercial or industrial site, you should contact the site beforehand to determine possible risks and to review risk management procedures.

The key knowledge in Units 1 and 2, especially when compared with Units 3 and 4, is very open, allowing flexibility for you to use contexts that are relevant for your students and taking into account your school's resources. What you need to focus on primarily is that you are delivering the outcomes in each unit and that you cover the key knowledge and key skills. You can weave in other components of the study design that we have already looked at.

The key part of the outcome for Unit 1 Area of Study 1 is to look at the relationships between biotic and abiotic factors in the environment, so this is largely looked at in real settings outdoors. It may be a small area in the school grounds. It might be a local park or natural environment, but it could also involve simulations to supplement outdoor experiences.

Students should already have covered ecosystems and relationships between biotic and abiotic factors at years 9 and 10, but this is extended in this area of study by considering ecosystems from an Earth systems approach, that is, how the atmosphere, biosphere, hydrosphere, and lithosphere are interrelated. How does something in one sphere affect another sphere? For example, different atmospheric conditions may affect different plants' capacity to photosynthesise, which then affects food chains in the biosphere. Fertilising a crop may involve improvements in the lithosphere and increased crop yield in the biosphere, but runoffs into local streams and rivers might adversely affect the hydrosphere. It will be up to you to choose whichever examples would be relevant to your students and in your own environmental settings.

There are two subsections for this outcome. The first subsection relates to local ecosystems and there are two key knowledge points that you need to cover. In selecting context, pick out the main words in the key knowledge to think about how this can be taught in your class. The word investigation implies practical work of some kind. Biotic and abiotic components of ecosystems can be explored through relevant fieldwork, for example. Biotic components will build on students' understanding of ecosystems from Year 9 and 10, and looking at the concept of keystone species and more complex feeding relationships is what you might think about. Abiotic components can be investigated through environmental monitoring. Collaborate with those in the chemistry department at your school to access equipment and materials for tests such as those for pH, and air, water and soil quality. These investigations will lead students to begin to think about Earth as a set of four systems, leading into the next section of this area of study.

The second part of this outcome looks at Earth systems more closely. You can select your own examples to show interactions between two or more of Earth's systems - that is the atmosphere, biosphere, hydrosphere, and lithosphere. You might like to start with processes that may be familiar to students, such as photosynthesis, respiration, and the water cycle, and then extend to consider other processes such as the nitrogen cycle or anaerobic respiration. You might also want to look at ecosystems that you've already explored in the first part of this area of study to go into more depth in terms of unpacking how Earth's systems work together. Concepts of open and closed systems could be explored, and you might like to compare Traditional Ecological Knowledge with an Earth systems thinking approach in terms of similarities and differences.

Unit 1 Area of Study 2 is about changes to Earth's systems over time. Our focus here is on looking at the management of a selected environmental challenge. The context is completely up to you to determine.

The first part of this outcome looks at change over very long periods of time, so you may start with plate tectonics or mass extinction of species - which may be familiar to students from earlier studies - and build on this knowledge by looking at Milankovitch cycles or the Great Oxidation Event. You could then look at changes in disruptions by choosing your own context, such as seasonal patterns, climate effects, species interactions, or farming.

The focus in Unit 1 Area of Study 2 is the use of both data and models to look at Earth's systems and the change in them over time.

It would be good to expose students to a range of techniques from using a hand lens to look at the composition of different rocks and minerals, to using sophisticated images that you can download from websites, such as NASA and geological organisations. Online simulations are particularly useful for students to look at changes over time.

Probably the most exciting part of this final section of Unit 1 Area of Study 2 is providing students with opportunities to look at solutions to environmental challenges. You could examine case studies to see how different stakeholders can work together to develop mutually acceptable future action plans. Students could work with citizen science groups to contribute to data collection, or become involved in the improvement of the quality of their local environment. They may explore practical options, such as testing the effectiveness of different designs for bird boxes or planting a butterfly friendly garden.

As an example of the flexibility of teaching options, you could set up a problem-based learning scenario, such as this one on erosion, as a way of exploring change in Earth's surface and spheres. There are many environment-based STEM projects that could be used as part of your teaching and learning programme.

Unit 1 Area of Study 3 involves students undertaking an investigation to generate primary data. The investigation can relate to Area of Study 1 and/or 2, and can involve different methodologies, for example, fieldwork, experiments, modelling, simulations, or the development of a product, process, or system. Students could use the same methodology or different methodologies as the basis of their investigations, but you need to ensure that the tasks for assessment are comparable in demand and time taken for completion. There is a mandated assessment task for this outcome, specifically that students present their findings in an appropriate format, for example, a poster, an article, a multimedia, oral, or visual presentation, so there is equity no matter what methodology is used.

Often, students or teachers use Unit 1 Area of Study 3 as an opportunity to develop their capacity to present investigation findings in a scientific poster format. In this example, a student undertook fieldwork to investigate relationships and interdependencies in a local ecosystem in terms of the nutrient requirements of different living things.

In this second example, a student undertook a controlled experiment in relation to changes in Earth's surfaces due to fire.

Unit 2 Area of Study 1 is about pollution and its management. A focus here is on looking at how pollution may have effects on more than one of Earth's systems and how the pollution can be managed. You can choose your own pollutants of local, national, and/or global interest.

The first of the two subsections in this area of study looks at the effects of different pollutants. You can select as many pollutants as you like to make sure that you cover pollutants with the different characteristics specified in the study design, for example, the concepts of tolerance limits and LD50. The selection of the pollutants to be studied may range from you selecting the set of pollutants through to students nominating appropriate pollutants, or a combination of the two.

The second subsection of this area of study focuses on methods used to quantify and manage pollution. This could relate to the pollutants selected in the first section of area of study, but could be supplemented by new pollutants to consider. Innovations in managing pollutions should be emphasised so that students can see how human endeavours are used to improve the state of the environment.

For Unit 2 Area of Study 1, case studies are often used by teachers. If this is your first time teaching Environmental Science, then you may want to start with one case study that the whole class explores. Mostly, local case studies are used. This is an Australian example related to an oil spill, but you could also use a local case study or international examples.

One approach to using a case study is to set up a problem-based learning scenario as previously mentioned. In this slide, I've used the example of managing oil spills. You can start by exploring basic elements related to the case study which may be familiar to students, in this case, seeing the effects on feathers of oil and water and then building to consider the nature of oil as a pollutant and how it might be managed. A mixture of practical activities and literature research can facilitate student learning, particularly if students can share and discuss their findings.

Unit 2 Area of Study 2 is about achieving food and water security. Again, you can use your own teaching and learning examples here.

The first subsection looks at sustainable food systems, including challenges in supplying adequate and affordable food. You could look at issues related to increasing populations, such as the implications of an ageing population, and changing food habits, such as veganism or a preference for organic foods. There is a focus on looking at monoculture agriculture systems as an example of farming practices. This area of study lends itself well to activities such as surveys to determine stakeholder attitudes to issues such as food sources, farming methods, and dietary choices. It also provides opportunities for students to analyse data related to food production.

This second subsection looks at maintaining food and water security. There are many online ecological footprint calculators that can be accessed in looking at footprints of individuals or organisations, or footprints of a food or product. You can choose your own local and national examples to illustrate different strategies and options for improving food and water security, including students' own ideas in terms of improving water efficiency at school and in the home.

Some teachers align study design content to special days in the year, for example, Sustainability Seafood Week and World Oceans Day. This requires careful sequencing of topics when planning your teaching and assessment programme at the start of the year. Activities associated with these special days are often linked to assessing science communication where students present to younger peer groups at their school or to upper primary school students.

As well as assessing science communication, tasks such as data analysis, a photo journalism product, a designed response to a problem, or the evaluation of stakeholder perspectives obtained through interviews or surveys could also be used to assess students' skills and understanding. Articles such as the one listed on the slide could also form the basis of a media analysis task.

For Unit 3 Area of Study 3, it would be expected that students undertake their own literature review as a scientific methodology to respond to a question of interest. You may select the topic to which students respond, or you can support increased student agency by working with students to help them develop their own questions of interest. It is likely that students will spend time out of class researching their topic. You will need to put strategies in place to ensure that students' work can be authenticated. A VCAA record of authentication form can be accessed through your school's VASS system for this purpose.

You should develop and document your teaching and learning plan. Although the planning template in this slide is generally used for new schools delivering VCE studies, it is very useful for all teachers in planning their own programmes. It allows you to think about how you will integrate and map key knowledge, key science skills, learning activities, and assessment tasks across the school year. You can use the QR code to access the template for your own purposes.

We will now look at assessment for Units 1 and 2.

All VCE assessments, both internal and external, must comply with the four VCE assessment principles shown in the slide. Being valid and reasonable means that content outside the study design should not be assessed. Equity relates to all students having the same access to assessment tasks and that no student is either advantaged or disadvantaged by the assessment. To achieve balance, you should think about the range of assessment tasks used. If you always use tests to assess student understanding at the end of each unit of work, then your assessment would not be balanced.

There are many different ways that students' knowledge and skills can be assessed. You may also consider breaking up assessment so that there may be some short tasks that might provide evidence of the quality of student learning. A 20-minute quiz or a 10-minute reflection can provide information about a student's learning. This can be used for formative as well as summative purposes. For all assessment tasks, you should always cross-reference to the Outcomes in the key knowledge and key science skills to ensure that your task meets the VCE assessment principles.

For Units 1 and 2, assessment is school-based. You need to report an S or an N to the VCAA, but your school will decide how results of student achievement are reported. It may be as an A to E grade. It may be as a percentage. It may be as a qualitative description. Your school should also have a policy that specifies how students who may have achieved an N can have further opportunities to achieve an S. The study design lists a set of 12 assessment tasks on pages 23 and 28 for Outcomes 1 and 2 in Units 1 and 2, but none of these are mandated. You can choose your own tasks. However, if you use more than one task for an Outcome, it must be different. For a unit, you also cannot choose the same task twice. This helps to achieve the VCE assessment principle of balance.

There is a mandated task for Unit 1 Outcome 3 relating to a student-adapted or student-designed investigation. And in Unit 2 Outcome 3, the mandated task relates to a student response to an investigation about pollution or food and water security. These mandated tasks can be presented by students in any format that you choose.

Teachers will set one or more assessment tasks to determine students' level of achievement. This can relate to any part of the Outcome statement or the entire Outcome statement. In general, these assessment tasks also contribute to the determination of an S or an N for the unit. For a student to be awarded an S for a unit, all parts of the Outcome must be demonstrated. This does not necessarily have to be formally assessed. It may be that the completion of set work in class may be evidence of a student having achieved part of an Outcome, such as evaluating an online ecological footprint activity.

You may also verbally ask students questions to allow them to demonstrate part of an Outcome, or you could assess work that's been completed in their logbooks to decide whether part of an Outcome has been met. What is important in deciding whether a student has met an Outcome is to look at the verbs in the Outcome statement to determine the depth of understanding that is required. It is not enough, for example, that a student just completes an ecological footprint activity. An evaluation of the results needs to be undertaken.

This is the template for the scientific poster for Unit 4 Area of Study 3. This is also used by teachers for Units 1 and 2, so that students can develop their skills in presenting investigation findings in a poster format. A 600-word limit applies for Units 3 and 4, but teachers at Units 1 and 2 can set their own limits and poster requirements. It is expected that if this poster format is used, that related sections in the logbook would also be assessed.

You can click on the QR code for rationale as to why a succinct scientific communication is important when using a poster format to display investigation results.

I've included five examples of investigations presented in a scientific poster format to show you how different scientific methodologies can be used in student investigations. In this example, fieldwork involving testing of phosphate levels at various points in a local river system was used as the basis of the investigation. The student’s conclusion included a suggested reason for the investigation findings, but this is not always necessary.

In the area of study looking at changes in Earth's systems, the teacher had selected erosion as the focus. Students modelled and tested different proposed solutions to control erosion as small-scale representations of the real thing. Students might work together on the modelling, but the report of their investigation should be completed individually. In these cases where work leading up to the assessment task is shared through group work, it may be appropriate for you to include reflection questions about the project or implications of the project to which students respond as part of their individual assessment.

This investigation involved a correlational study where none of the experimental variables were manipulated. Students took various air quality measurements at different distances in the school yard from the highway located outside the school and used graphs to look for correlations.

Fieldwork can be qualitative or quantitative. In this assessment task, students were assessed on their capacity to interpret quantitative data. As well as the poster, the student assessed the data representations and calculations in students' logbooks.

Controlled experiments can often be developed from questions arising in fieldwork activities or from class discussions. This type of controlled experiment is an easy way to manage different investigations in the class. Students could test different examples of natural fertilisers or different types of seedlings. Although students would report only on their own findings, the comparison of class results would be interesting in terms of comparing requirements for ecosystem integrity.

I wanted to finish by encouraging you to consider different ways of assessing students and integrating assessment into learning. The study design offers 12 assessment alternatives for Outcomes 1 and 2 in Units 1 and 2. Outcomes 3 in each unit have mandated assessment tasks associated with them. Many schools also use tests and scheduled examinations as part of assessment. The STEAM project represented by the three icy poles in this slide could be readily adapted into a teaching and learning activity with students sampling various locations for pollution. As an assessment task, students may be required to quantify pollutants in the three different locations and to organise data into a table. Results could be graphed and/or represented proportionally as in these icy poles as a visual way of demonstrating data. As part of the assessment, students could annotate their photographs of the three icy poles to compare and discuss pollution in terms of how pollution may affect Earth's four systems. Assessment is up to you to determine, as long as it aligns with the Outcomes in the study design.

This was an overview of content and assessment for Units 1 and 2. A live Q&A session is planned for February 2022 so that I can respond to any queries that you may have, but please feel welcome to contact me at any time if there's anything you'd like to know or to discuss. My contact details are on the slide. I look forward to continuing to work with you.

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