Teacher Guide
Program Information

Sprouting Science
EDUCATION

Sprouting Science is an innovative, inquiry-based primary science program.

Our mission is to provide teachers with complete, ready-to-teach units of work that are engaging, high-quality and scientifically accurate.

We use the most recent evidence to craft lessons using teaching practices that are proven to lead to better outcomes for students.

A key focus of our program is to develop students' **scientific identity**, which is about students:

- finding science to be useful, relevant and meaningful to their everyday life
- using science to challenge social and environmental inequalities, and
- recognising how they can be part of solutions, both individually and collectively (OECD, 2020).

Sprouting science creates complete units of work that:

- ✓ Are aligned to the Australian Curriculum: Science
- ✓ Use evidence-based teaching practices
- ✓ Follow the 5Es teaching and learning model
- ✓ Embed hands-on activities and investigations
- ✓ Contain accurate science content knowledge
- ✓ Can be adjusted to suit class time and abilities
- ✓ Incorporate the Design and Technologies curriculum
- ✓ Connect to the general capabilities and cross-curriculum priorities.

The 5Es unit sequence

Each unit is a set of learning experiences that follow the 5Es teaching model: *Engage*, *Explore*, *Explain*, *Elaborate* and *Evaluate*. This is designed to develop students' conceptual understanding and skills to meet the achievement standard of the Australian Curriculum.

Phase	Lesson type	*Sprouting science* lesson focus
Engage	Diagnostic	• Engages students' curiosity, provides opportunities to make connections between past and present learning experiences. • Identifies what students already know and what their misconceptions are. • Identifies students' strengths and weakness providing information to the teacher about which content needs to be focused on.
Explore	Conceptual*	• Provides students with a common base of experiences which helps them develop concepts and skills. • Helps students form a clear understanding of the concept through hands-on activities where they make connections and patterns within the key ideas.
Explain	Conceptual	• Provides students the opportunity to represent or re-represent their understanding of the concept. • Includes the teacher explicitly explaining the concept to reinforce what the students have learned.
Elaborate	Conceptual and/or STEM inquiry*	• Students extend their understanding in a new context, such as an investigation, to develop both their inquiry skills and a deeper and broader understanding of the concepts.
Evaluate	Summative	• Enables students to assess their understanding and abilities. • Provides opportunities for teachers to evaluate student progress toward achieving the success criteria.

*Further information about the framework of this lesson type is provided later in this guide.

Scientific explanations and representations

Within each *Sprouting science* unit, representations and explanations of the science concepts include text, images, videos, animations, hands-on activities and investigations, teacher demonstrations, guided practice and analogies.

Students are provided with multiple opportunities to represent and re-represent the content to support their understanding of the topic (Tytler et al., 2013).

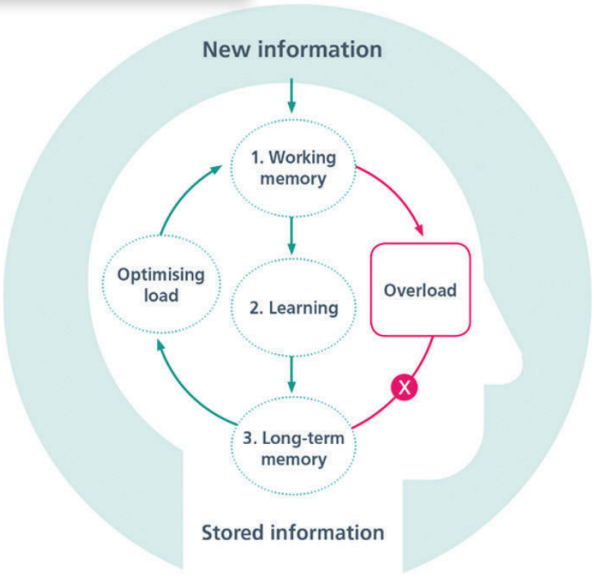
Lesson slides generally contain an interactive activity such as a pair-share or questioning activity. These make students' ideas visible through constructing their own explanations or engaging in discussion of the science concepts.

The *Explain* phase provides more formal re-representation of ideas, including comparing diagrams to find patterns, drawing labelled diagrams and making evidence-based claims. Worksheets are provided to help capture and record students' representations.

Explicit instruction and cognitive load

The *Sprouting science* approach is underpinned by cognitive load theory. This theory states that '*learning can be slowed down or even stopped if our working memory is overloaded, such as when we have to process too much new information at once*' (Centre for Statistics and Evaluation, 2017).

Learning happens most efficiently when teaching is clear, systematic and does not leave students to construct or discover information without any guidance (*Australian Education Research Organisation,* 2021).



Source: Centre for Statistics and Evaluation, 2017.

Sprouting science uses practices of explicit instruction by:
• Making the purpose and relevance of each lesson clear through learning intentions and the success criteria.
• Breaking concepts and skills down into small, sequenced tasks with exemplars as necessary.
• Using worked examples to teach new skills.
• Having frequent engagements with provided information and quick reviews of previous learning.

Assessment

Different forms of assessment occur across the unit, providing teachers with multiple opportunities to collect information about each students' progress.

Sprouting science includes the following types of assessment:

Diagnostic assessment

This is primarily conducted during the first lesson to provide teachers with information about students' existing knowledge and misconceptions.

This information can be used to plan which areas to focus on in the subsequent teaching of the unit (see page 7).

Formative assessment

Assessment for learning

These are frequent, informal and interactive assessments of student progress through classroom observation and interaction.

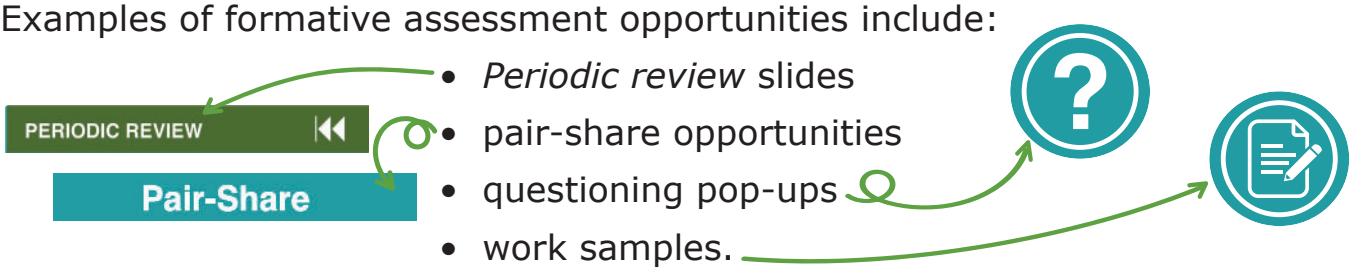
This assessment provides the teacher with feedback during the lesson on students' progress and what content may need to be retaught before continuing on to the next lesson.

Assessment as learning

This occurs when students reflect on and monitor their own progress to help them understand the next steps in learning.

A formal opportunity for students to reflect on their progress is provided during the *Lesson closure* slides.

Examples of formative assessment opportunities include:



- *Periodic review* slides
- pair-share opportunities
- questioning pop-ups
- work samples.

Summative assessment

Summative assessments are used to measure what students have learned so teachers can make judgements on student achievement against learning outcomes and achievement standards.

The exit quiz and lesson closure provide an opportunity to assess students' understanding at the end of each *conceptual* lesson.

A grading matrix is provided to assess students' work created during a *STEM inquiry* lesson. It can be used to grade students using the summative assessment provided for the final lesson.

Conceptual lesson framework

Bybee (2014) noted that there are challenges with using the 5Es model for an entire program (i.e. more than 2-3 weeks) as the perspective for each phase loses its effectiveness. In order to address this, while the *Sprouting science* units follow the 5Es model, the conceptual lessons are structured using a **mini-5Es** sequence around the specific concept of that lesson. This ensures students have the chance to represent and explain what they have explored whilst the experiences are fresh in their minds.

Lesson phase	Purpose	Timing*
PERIODIC REVIEW	Revises the previous two conceptual lessons to reinforce the key ideas again and to make links with this next lesson.	15 mins
ENGAGE	Stimulates students' curiosity for the concept developed in the lesson. Provides an opportunity for a *questioning* diagnostic assessment activity.	
LEARNING INTENTION	Introduces the guiding questions for the lesson and outlines key success criteria.	
EXPLORE	Students explore the concept through hands-on and/or minds-on activities. Key vocabulary is introduced.	10-30 mins
I DO I DO YOU DO	Where relevant, guided practice is used for teaching science inquiry or literacy skills.	
EXPLAIN	Students re-represent their understanding of the concept and scientific explanations are given. A quick assessment of students' understanding of the lesson concept is provided.	10 mins
ELABORATE	Students apply their new knowledge and skills in a different context, through an investigation, a design activity or to a new concept.	10-30 mins
EVALUATE LESSON CLOSURE	Students complete an exit quiz and a self-assessment of their learning. There is a also a glossary which is referenced to as needed.	5-10 mins

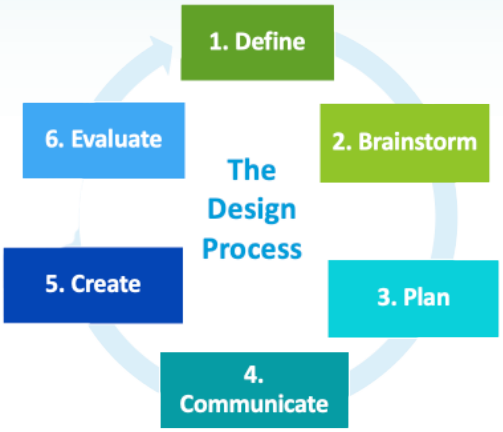
*Timings provided are a guide. They will vary depending on numerous factors including focus of the lesson and class skills, knowledge and energy levels.

For this reason, an opportunity is provided on the last *Explain* slide to skip directly to *Evaluate*. As there are full *Elaborate* lessons later in the unit, that section of the conceptual lesson can be skipped if necessary.

STEM inquiry lesson framework

Once scientific concepts are developed, students have a chance to apply what they have learned in a STEM inquiry during the *Elaborate* phase.

The two main types of inquiry used in *Sprouting science* are outlined below. Each step is introduced to students at an appropriate level to develop their inquiry skills. The inquiry will also have a different level (detailed below) depending on what the focus is.

	Science investigation	Design task
Lesson phases		
Confirmation inquiry	Students conduct an investigation where the teacher provides them with the question, method and results. Students confirm that the results and conclusion are correct.	Students follow a plan provided by the teacher to create a specificed solution to a design brief. Students confirm whether the solution works as intended.
Structured inquiry	The teacher provides the question and procedure. Students conduct the investigation and formulate an evidence-based conclusion.	The teacher provides a solution and a proposed plan. Students review and modify the plan before creating and evaluating their version of the solution.
Guided inquiry	The teacher provides the question for investigation and helps students plan the method, find the materials required and identify how the data will be collected and collated. The investigation results are generally not predictable.	The teacher provides the design brief and helps students to brainstorm solutions, plan how to make it, communicate and create it. Solutions are likely to be very different between each student.

Flexibility and adaptation

There are many factors that affect how much time teachers have to teach science. This includes differences in how much time is allocated by states and territories to teach science, the needs and abilities of the students, and the myriad of interruptions to the school day.

To allow for these factors, *Sprouting Science* has designed a framework that is flexible, allowing teachers to adapt lessons as needed without compromising the lesson key content. Opportunities for adaptation include:

Diagnostic assessment

PRIOR KNOWLEDGE

The first lesson in the unit supports a diagnostic assessment of what students think they know and can do. This can inform planning of the unit, for example, if students are already well aquainted with a concept that is the focus of a later lesson then that lesson may be skipped. That would leave more time, for example, to take full advantage of the investigation skills developed in the optional *Elaborate* section of another lesson.

Conceptual lesson options

As seen on page 5, the conceptual lessons are structured using a 5Es sequence around the specific concept of that lesson. An opportunity is provided on the last *Explain* slide in the lessons to skip directly to *Evaluate* to support teachers who have less than one hour once per week to teach science or need to shorten the lesson for other reasons.

Questioning options

Wherever a question box appears, teachers have the option of choosing only one or two students to answer the questions or to spend more time, for example, by using them for pair-share opportunities or having a longer class discussion.

Exit quizzes

EVALUATE

These act as a quick summative assessment of learning to help teachers check the concept has been understood or whether the class needs further support. If teachers are confident that students have a good grasp of the lesson content, the exit quizzes can be skipped.

Group work

WE DO GROUP YOU DO

There are significant advantages of students undertaking group work. However, depending on the class setting, group work may be time consuming or not suitable for various reasons. Activities that *Sprouting science* suggests to be completed in groups have an icon with 'Group' in dark blue to remind teachers that whilst the recommendation is for students to work in groups, the activity may also be completed as a whole class ('We do') and/or individually ('You do').

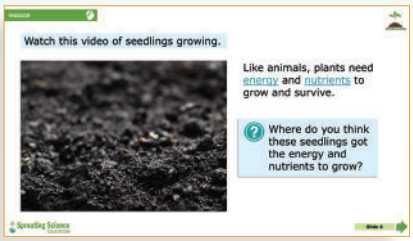
Sprouting science lesson elements

Each *Sprouting science* unit develops students' science understanding of one strand of the Australian Curriculum: Science. The unit provides seven or eight lessons to teach across a term and includes a final assessment.

Each unit consists of one-hour lessons, once per week. A recommended lesson timing for conceptual lessons is provided on page 5 of this guide. This is a guideline only. The lessons are designed be flexible to meet the needs of the class and the time allocated for science (see page 7).

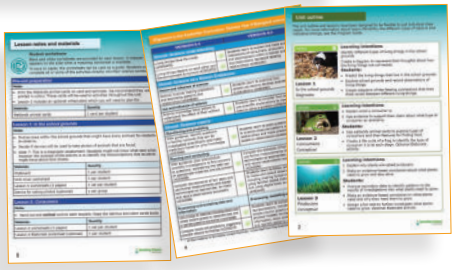
The lesson components include:

1. PowerPoint Lessons (Online)



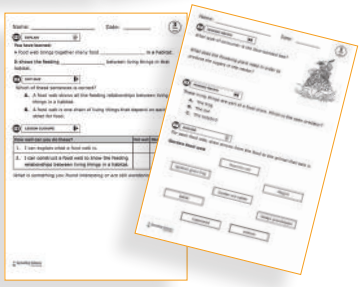
Each unit is a set of PowerPoint lessons that are conceptually sequenced to support students' learning of the science understanding.

2. Teacher Guides (Downloadable)



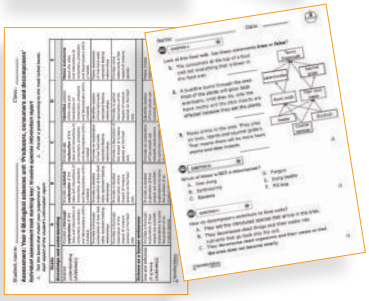
This Program Guide provides an overview of the *Sprouting science* program which is applicable to each unit. The Unit Guide supports the teaching of each unit.

3. Student Worksheets (Downloadable)



Black and white printable worksheets are provided for each lesson. Using these worksheets is optional. Teachers may prefer students to write directly in their workbook.

4. Assessment (Downloadable)



The STEM inquiry lesson and the final assessment provide formal opportunities to assess the science inquiry skills and the knowledge and understanding covered in the unit. A grading matrix is also included.

References

Australian Education Research Organisation. (2021, February). *Explicit instruction Know how to teach your students*. https://tinyurl.com/ycystnsj

Bybee, R. W. (2014). The BSCS 5E instructional model: Personal reflections and contemporary implications. *Science and Children*, 51(8), 10-13.

Centre for education statistics and evaluation. (2017, September). *Cognitive load theory: Research that teachers really need to understand*. NSW Government. https://tinyurl.com/vxneu7d3

OECD. (2020). *PISA 2024 Strategic Vision and Direction for Science.* https://www.oecd.org/pisa/publications/PISA-2024-Science-Strategic-Vision-Proposal.pdf

Tytler, R. Prain, V., Hubber, P., & Waldrip, B. (2013). *Constructing representations to learn in science* Springer Science & Business Media.