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SUGGESTED TIME FRAMES

Although each module is important, the amount of time classrooms spend on each is flexible. Because the curriculum follows the stages of design thinking, it is far more important to utilise all of the modules in some way than to feel constrained about devoting a certain amount of time to each one.

The entire unit can be completed in six class periods, but it can also stretch to six weeks. Suggested time modifications are provided throughout in order to make this curriculum accessible to classrooms with a range of time, resources and student size.

It is recommended that you begin each module by anchoring students in design thinking and reminding them of the purpose of the module. This can be a simple 30 seconds at the top of the lesson when the teacher or a student points to one of the created visual aids and says aloud which stage of design thinking the class is in. (These visual aids will be created during the Getting Started Module.)

The Getting Started Module is the most compact, requiring only a single class period of between 45 and 90 minutes.

The most in-depth module is Module 3, which introduces mini-lessons about the scientific process and a total of six experiments about the properties of water. Your classroom might choose to devote a week to Module 3 while only devoting single class periods to the other modules. On the other hand, your classroom might decide to use fewer of the experiments and complete Module 3 in one or two class periods.

Sample Time Frame

Each module includes an at-a-glance time frame chart. This allows you to determine which activities and mini-lessons to include for your class based on the time you have available for any given module.

Time Period	One Regular Period (45–90 min.)	One Extended Period (90–120 min.)	One Week (5 Class Periods)
Activities	<ul style="list-style-type: none"> • Research • Write • Define a problem 	<ul style="list-style-type: none"> • Research • Write • Define a problem • Share 	<ul style="list-style-type: none"> • Introduce the module • Research • Outline/draft • Revise • Define a problem • Share • Discuss/give feedback • Concluding Activities

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One Class Period: The entire class works together researching by reading a single article. They work collaboratively to write a single-paragraph response as the teacher leads the process. Using this response, they then discuss and define a problem they will solve in the remaining modules.

One Extended Period: Students work in small groups, each group choosing a different article, creating its own short write-up (a single paragraph) and defining its own problem, which it then shares with the entire class.

One Week: Students work in groups or individually on articles of their choice; they write multi-paragraph responses to the articles they read, possibly even incorporating additional research they conduct in class via the internet. After writing, each student or group defines the problem and then all students share with the class. Finally, students write about their experiences via journal entries and/or blog posts.

- **Day 1:** Select, read and annotate articles.
- **Day 2:** Conduct additional research.
- **Day 3:** Outline and draft responses; consult with other groups/students. Brainstorm problem statements.
- **Day 4:** Revise and edit responses and problem statements.
- **Day 5:** Share and discuss responses and problem statements. Students take notes about the feedback they receive in order to build ideas for the next module. Students complete journal entries and/or blog posts.

TECH CONNECTIONS

Although this unit doesn't rely on technology for its presentation and application, we have designed this unit with technology integrations in order to help students share their work and also practise effective digital habits. Although optional, the tech connection component of each module has several benefits, as follows.

This unit of study has themes of iteration and graduated growth at its core. If students have an avenue for publishing their work, they will have an intrinsic motivation to give their best effort. Sharing work outside the boundaries of the classroom lends a feeling of seriousness to what students are doing and encourages them to push themselves so that each new draft or iteration of the project becomes something of which they will be proud. Sharing the project online is an accessible and inexpensive way for students to achieve the benefits of publishing in a public sphere.

Additionally, publishing their work online via social media and using hashtags will allow students to make real-world connections with professionals in the STEM fields they are exploring in this unit. They will have a taste of what it is like to operate within the scientific community and hopefully become inspired to continue and grow the connections they make. Students will be more likely to see the value in what they do in the classroom – and thus invest in their learning

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– when they see the possibility of engaging with real-world problem solvers and issues.

Finally, the suggested tech connections will help students build healthy internet habits and social-emotional skills by interacting with others. A lot of emphasis is placed on what not to do online for younger students. We see great value in helping upper primary students learn what they *can* do, thereby empowering them to become productive and responsible internet users and social media participants. Students will be able to apply the concepts of empathy they are learning in this unit to their interactions with others as they navigate the online space.

Tech connections can be made in a number of ways. We highly recommend avenues that allow the entire class to participate together. This includes, but isn't limited to, a classroom Twitter account, a classroom Instagram account, a classroom Facebook page and a classroom blog on a free blogging platform. (See Appendix B for suggested platforms and resources for adding images to blog posts.) Using the hashtag #couldyouliveunderwater will enable your students to see what other classrooms are doing with this unit of study, further exciting and inspiring them.

At the end of each module, you will find specific suggestions for utilising the tech connections, including ideas for blog and social media posts.

WRITING CONNECTIONS

There are plenty of opportunities for students to utilise and hone their writing skills as they summarise and reflect on their learning. Each module has suggestions for journal entries that students can complete and add to their Design Notebooks. These informal responses allow students to reflect on their feelings, learning, and triumphs and challenges within a module.

Following each module, you will also find suggested blog titles. For classrooms maintaining a blog to document and enhance this unit, the blog posts are opportunities for students to practise more polished writing that will be published. The suggested titles are intended to point students in helpful directions and spark their thinking, but, of course, they can invent their own blog post topics and titles. Your students might use the suggested titles as templates, personalising common blog title structures to fit their unique ideas.

Some modules contain more formal writing projects, such as essays, reports or letters. When these appear, you will find student handouts with frames and/or outlines so that students have some parameters for structuring their thoughts. These writing templates can be switched out for outlines and processes that your class uses regularly or that you know are successful for your students.

We highly recommend that students share their writing with their peers for feedback and inspiration, as well as to encourage them to put their best work forward, knowing others will read it. To that end, we have included material for guiding your students through the process of offering feedback. In Module 1,

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you'll find Mini-Lesson 1.5: What Should I Say?: A Guide to Effective Feedback. The skills from this mini-lesson can be used throughout the entire unit to help students provide one another with constructive criticism.

MATERIALS

All modules require Design Notebooks for students to use for the duration of the project. These should be three-ring binders (one for each learner) with dividers for each module (six for each learner). The Design Notebooks allow students to compile writing and drawings that they complete over the course of the unit. The Design Notebooks begin empty except for the dividers. Students will fill and construct their Design Notebooks throughout the unit, eventually creating tables of contents for them in Module 6.

Having binders that students fill with their work allows students to hand-write neatly or type, depending on the needs of their classroom, and all papers can simply be hole-punched and added to the correct section of the binder. The last module provides time and instruction for students to gather and organise all of the materials they have created into their Design Notebooks. Whether students transport their Design Notebooks back and forth between school and home, or whether they leave them in the classroom and complete any assignments on binder paper, is up to you.

Each mini-lesson includes a list of suggested materials, including student handouts and other resources. Some specific materials related to the modules are described in this section in more detail.

Getting Started Module

The Getting Started Module requires materials for creating posters or infographics about design thinking, such as unlined paper or poster paper, as well as crayons, textas or other art supplies.

You will need to create an example visual aid of the design thinking process, as outlined in the Getting Started Module, to present to students. Before teaching this lesson, you will need to go through the module on your own and make the visual aid described.

Module 2

Module 2 requires research materials about the ocean that focus on pressure, density, temperature and impact on artificial materials and on potential dangers to humans, such as predatory animals, extreme conditions or toxic elements. These might be articles found online or books checked out from the school or local library. There are a few articles listed on Handout 2.5 to get you started.

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Module 3

Module 3 features six unique experiments. The materials and instructions for each are included on the handouts in this module (see pp. 82–93).

Module 4

Module 4 has students begin building their prototype underwater habitats. Classrooms may gather whatever supplies they like for building prototypes. This is a great time to engage learners' families and ask what kinds of materials they may be able to supply at low cost or for free. When choosing what materials to bring into your classroom for the building portions of this book, do not overthink things. A random scattering of household items and what you normally might recycle are ideal for prototyping and building the underwater habitats. The goal should be for all students to have access to the same materials. Designs will vary from student to student, but you can get students thinking in the right direction by encouraging them to include the following elements:

- a frame
- a covering that contains the frame
- a waterproofing element.

Here are some suggested building materials:

- Duct tape
- Cardboard
- Used recyclables (such as cleaned milk cartons, toilet paper roll tubes, paper towel tubes, paper and plastic shopping bags, etc.)
- Cardstock
- Masking tape
- Electrical tape
- Aluminium foil
- Plastic cling wrap
- Pipe cleaners
- Twist ties
- Paraffin wax (the kind commonly given to orthodontia patients)
- PVC pipe (cut into 15- to 20-centimetre lengths)
- Hot glue gun (and glue sticks)
- Brads
- Tacks
- Glue sticks
- Stapler (and staples)

Module 5

Module 5 requires students to test their prototypes. You will need a clear plastic storage container (32–40 litres in size), water to fill the container and

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salt to approximate the ocean's salinity (around 3.5%) in the testing container of water. Use approximately 35 grams of salt per litre of water.

Module 6

In Module 6, students will need pens, textas, crayons, paints, etc. to create final presentations of their projects and to finish their Design Notebooks.

MEETING STANDARDS

This unit is designed to be adapted for use within a variety of classroom settings. Thus, the standards it addresses will vary based upon an individual classroom's needs and how the instructor chooses to implement the unit.

But by its very nature this unit meets the Australian F-10 Curriculum: Technologies standards for Years 5 and 6. The core of the unit asks students to conduct research and analyse the ways in which they can use scientific thinking to protect the Earth's resources and environment. Their main activity will be to define a simple design problem that reflects a need and that includes specific criteria for success and constraints on materials and time.

Furthermore, this unit meets several F-10 Curriculum: English standards for Years 5 and 6 when classrooms utilise the included writing projects and suggested assignments, including the upkeep of a classroom blog.

To see specific standards addressed, the end of the unit includes an Australian Curriculum standards alignment chart.

ASSESSMENT

Throughout the unit there will be an opportunity to utilise specialised assessment rubrics that help you evaluate your students based on core skills they are learning, not only related to STEM and writing topics, but also to social-emotional skills, such as collaboration and working with purpose. Each of the following rubric descriptions includes recommendations about where and how to use each rubric. The rubrics are included in Appendix C.

Writing Assessment Rubric

Recommended for use with Modules 1, 2 and 6, and any modules for which students complete writing assignments in the Concluding Activities section. Use this rubric to evaluate students' completed writing for this unit. The maximum number of points is 100 (20 points for each of the five categories). Points should be awarded between 0 and 20 as you see fit.

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Hands-On Activity Assessment Rubric

Recommended for use with Modules 3, 4 and 5. Use this rubric to evaluate students' work on the guided experiments as well as on designing and testing their prototypes. The maximum number of points is 100 (20 points for each of the five categories). Points should be awarded between 0 and 20 as you see fit.

Design Notebook Assessment Rubric

Recommended for use with Module 6. Use this rubric to evaluate students' completed Design Notebooks. The maximum number of points is 100 (20 points for each of the five categories). Points should be awarded between 0 and 20 as you see fit.

Other Forms of Assessment

Students will also have the chance to evaluate one another's work. In the Getting Started module, Module 1 and Module 5, they will use rubrics, handouts or the instructions provided in mini-lessons to provide peer assessment. These should be seen as opportunities to help set a positive tone of collaboration and fair-minded evaluation among your students.

Students will also have the chance to self-evaluate in this unit. Module 4 includes a Self-Evaluation Handout (Handout 4.5) that helps students think critically about the success of their prototypes. In addition, each module includes journal prompts that encourage students to reflect on their performance during the activities. You might choose to utilise these as part of the assessment process so that students have a hand in evaluating their own performance throughout the unit.

SHARING STUDENT WORK

We highly recommend displaying student work from the outset of this unit. Share it proudly in the classroom and beyond. Within the classroom, consider displaying the posters students create about design thinking, as well as their drawings of designs, their responses to the articles they read in Module 1, and any other work produced that is inspiring, or of which students are particularly proud.

Photos and videos of student work and the writing they complete to reflect on the project in the Concluding Activities of each module can be shared online via a class blog or social media accounts. For specific suggestions, make sure to consult the Tech Connections section of each module. If you would like to set up a classroom blog where your class can share updates and progress throughout the entire unit, check out Mini-Lesson 0.2 about making a classroom blog in the Getting Started Module.

HOW TO USE THIS BOOK

At the conclusion of this unit, provide students with an opportunity to share their completed Design Notebooks with their community. This might mean inviting staff, parents or other classes into your classroom for a tour of the Design Notebooks and the materials displayed on the walls and for a viewing of the student presentations from Module 6. It might also mean filming and photographing the Design Notebooks and the final presentations to share on the classroom blog or social media accounts. Find creative ways for your students to share their work. Each opportunity to describe what they have done in this unit deepens students' connection to their work and solidifies their retention of the design thinking process.

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