COULD YOU LIVE UNDERWATER?

A Design Thinking and STEM Curriculum Unit for Curious Learners

Builds creativity, collaboration, and critical thinking
Incorporates authentic, real-world learning
Teaches design thinking and STEM skills

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COULD YOU LIVE UNDERWATER?
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You are about to put some serious fun combined with deep learning into the hands of the bright learners you serve.

Here’s what we know for sure: How people live and work is evolving rapidly and shows no signs of slowing. The way we connect, play, and learn looks wildly different from even 50 years ago. This new way of being requires both a quicker reaction time and a more complex thought process from our students—in school and beyond. Wouldn’t it be great if there were a curriculum rooted in that reality that also imparted serious scientific knowledge while bolstering academic resiliency and risk-taking?

This STEM (science, technology, engineering, and math) curriculum for grades 4 and 5 teaches design thinking and valuable STEM skills via engaging projects that incorporate hands-on experimentation and building, research, active reading and analysis, writing, drawing, and creative reflection.

We wrote this book to help bring the best innovative thinking in successful 21st-century organizations into the hands of tomorrow’s builders and leaders.

Design thinking is a way of thinking that successful creators use to build the processes and machines that enrich human life—from building the Mars rover to bringing fresh drinking water to remote locations. This thinking process is spreading to businesses and government institutions, becoming the new standard of innovation. Although it’s great for building rockets, it’s not rocket science. Any classroom can employ design thinking without a huge investment in technology or specialized equipment.

So, what is design thinking? As the name suggests, it’s really just a way of thinking. It’s a mental approach to solving problems that encourages collaboration, creativity, resilience, iteration, brainstorming, experimentation, reflection, and the celebration of small successes.

This design thinking curriculum proceeds as follows: After an engaging introduction module, there are six distinct modules to this unit, designed to walk your class through the tenets of design thinking as it relates to creating an undersea
living space while addressing the complex issues of climate change and housing equity. Additionally, learners will explore the challenges that go along with making a life under the water at low temperatures and high pressure, with limited oxygen and other people in close quarters. The entire curriculum can be completed in six class periods, but it can also stretch to 6 weeks.

Students will love it because they get to design, build, and learn in a way that works for them. There will be a special appeal for kids interested in ecology and marine life. Creative thinkers and designers will get a kick out of inventing solutions to the problems of undersea living.

You will love it because you get to offer your students a real-world problem to solve while imparting the academic and critical thinking skills vital for success in an exciting and unpredictable future.

If those sound like traits you’d like to help build for your students, we think you’ll really enjoy this curriculum.

So, let’s dive in!

**Introduction to Design Thinking**

You may already know firsthand the power of problem-based learning. Students don’t merely think; they do. They apply what they learn, and they build lasting knowledge.

This curriculum utilizes problem-based learning to engage learners. It also, however, teaches them to define the problem they will solve and to assess their success in solving it.

Design thinking invites thinkers to define problems to solve based on the human experience. Using empathy and connection, design thinking helps learners frame problems in terms of the effects on human beings—individuals, communities, and groups.

It also builds the habit of iteration. Learners become comfortable with "failing forward"—revisiting their ideas and modifying them not based on arbitrary designations of "good" or "bad" from an authority figure, but based on whether those ideas really worked to address a given problem! This kind of learning builds independence and curiosity as it invests power in learners, not letter grades.

**The Five Stages of Design Thinking**

**Step 1: Empathize.** Learners connect with people who are negatively impacted by a situation or condition. They come to understand the nuanced causes and wide-reaching effects of this condition.

**Step 2: Define.** Learners narrow their thinking and define one specific problem that they want to work on solving. This problem is born out of the empathy engendered in Step 1. Yet, it is also logically defined as a clear goal. For example, "We want to make life better for those affected by climate change" obviously springs from empathy. But it does not define a problem. On the other hand,
this statement does: “We want to find new career opportunities for fishermen who have lost their livelihoods due to rising sea temperatures caused by climate change.” Here, the problem is clearly defined: Fishermen have lost their ability to feed their families; they need new ways of earning a living.

Step 3: Ideate. In this stage, learners bring all of their ideas to the table. They explore and tap into their creativity. Using collaboration at this stage is especially powerful. Learners also conduct research so that their ideas are well thought out and grounded in background knowledge.

Step 4: Prototype or create. Learners build their designs as prototypes, returning as needed to the ideation process when materials in the real world don’t behave quite as expected on paper. This key step brings their thinking into the world of materials and pushes learners to follow through on their ideas.

Step 5: Test. Learners test their prototypes based on specific and determined criteria. This stage is very powerful for learners as they experience a connection to practical outcomes. They’ll know exactly what standards their projects need to meet. Further, they’ll be able to observe for themselves whether their designs meet those standards! This is a very egalitarian mode of assessment. There is no limit to the number of designs that can be successful. There are not so many A’s ready to be handed out; there is simply the reality-based judgment of what works. What about the designs that don’t work? In design thinking, there are no failures; there are only iterations. Design thinking is recursive. The testing stage includes evaluating and taking notes about what could be done differently next time.

We’ve taken these design thinking elements as our foundation, and we’ve added two key pieces:

1. Guided experimentation that enriches students’ background knowledge of key science concepts. Conducting these experiments firsthand will allow learners to connect with and understand the principles they’ll be using in the design and prototype stages. Yes, they’re going to have the opportunity to research and learn. But they will also get the excitement of seeing scientific inquiry in action! This is key for engaging learners in STEM topics and fueling their curiosity.

2. Aspects of the writing process to help learners frame their thoughts, reflect on their experiences, and publish their findings. At each stage of the design thinking process, learners will use brainstorming activities, writing frames, and journal prompts to put their experience into words. They will also “publish” their projects by creating Design Notebooks and sharing their designs via the web. Incorporating these writing elements builds a bridge between STEM topics and language arts, helping learners of all strengths and thinking styles find success.
How to Use This Book

Following an introductory module to introduce students to design thinking and set the stage for those classrooms that will be building a student blog, there are six distinct modules to this unit. Module 1: Empathizing and Setting Up the Problem begins with a personal note to learners from an invented character, which is intended to encourage imaginative thinking and intrinsic motivation. They learn how to define a problem based on what they read and learn about the real-world effects of climate change, specifically in relation to changing housing conditions.

The remaining modules guide students through the remaining three stages of design thinking: (1) research and ideation, (2) designing and building prototypes, and (3) testing prototypes. Between the research and designing stages, students also conduct experiments to increase their understanding of the properties of water. Following the final stage, learners share their findings and respond to the invented character from Module 1.

Each module includes objectives, an overview, a Tech Connection section with ideas for utilizing the web to share what students are doing, a Writing Connection section with ideas for enriching student learning through writing, mini-lessons, student handouts, and a Concluding Activities section with suggested journal entries, blog post titles, and other projects, where applicable.

Each module builds on those before it. Skipping modules or completing them out of order will create a disjointed and unsatisfying experience for students. The minimum amount of time needed to complete each module is 45 minutes.

As classes work through the modules, students will be creating records of their experience via their Design Notebooks. These binders hold students’ designs, notes, worksheets, drafts, finished writing, and any supplemental work they create to document their design thinking journey. Students should be encouraged to personalize their Design Notebooks and to take pride in them.
**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 utilize 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 6 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.

<table>
<thead>
<tr>
<th>Time Period</th>
<th>One Regular Period (45–90 min.)</th>
<th>One Extended Period (90–120 min.)</th>
<th>One Week (5 Class Periods)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities</td>
<td>• Research</td>
<td>• Research</td>
<td>• Introduce the module</td>
</tr>
<tr>
<td></td>
<td>• Write</td>
<td>• Write</td>
<td>• Research</td>
</tr>
<tr>
<td></td>
<td>• Define a problem</td>
<td>• Define a problem</td>
<td>• Outline/draft</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Share</td>
<td>• Revise</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Define a problem</td>
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<td></td>
<td></td>
<td></td>
<td>• Share</td>
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<td></td>
<td></td>
<td></td>
<td>• Discuss/give feedback</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Concluding Activities</td>
</tr>
</tbody>
</table>
**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 practice 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 learn-