Program Overview
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About the Program

OpenSciEd is a comprehensive middle school science curriculum that empowers students to ask questions, design investigations, and solutions, and figure out the interesting and puzzling world. OpenSciEd empowers students to be the knowers and doers of science and develops a classroom in which the ideas we hear from our peers help to move our thinking forward as we develop our abilities to think, read, write and argue as scientists and engineers.

- **Phenomenon Based** - Centered around exploring phenomena or solving problems
- **Driven by Student Questions** - Storyline based on students’ questions and ideas
- **Grounded in Evidence** - Incremental building and revision of ideas based on evidence
- **Collaborative** - WE, the class and the teacher, figure out ideas together
- **Equitable** - Builds a classroom culture that values ideas and learning of all

The OpenSciEd Instructional Model:

The OpenSciEd Instructional model uses a **storyline approach** in which students are presented with puzzling phenomena that elicit a variety of questions that motivate the learning in the unit. In OpenSciEd units, phenomena are carefully selected to anchor a storyline and inspire the development of target disciplinary core ideas, crosscutting concepts, and science and engineering practices. These anchoring phenomena draw students into the storyline by presenting the natural challenge of explaining something or solving a problem. Other phenomena may be introduced at key points in a storyline to maintain interest or push students to delve more deeply.

To help teachers and students advance through a unit storyline, the instructional model takes advantage of five routines—activities that play specific roles in advancing the storyline with supports to help students achieve the objectives of those activities. The routines typically follow a pattern as students kick off a unit of study, surface and investigate different questions they have, put the pieces together from those investigations, and then problematize the next set of questions to investigate.
Built to engage, inspire and empower

Educators can leverage OpenSciEd to bring three-dimensional learning to life for their students, confident that the materials have been tested in classrooms with thousands of students across the country. Data from the field tests show that our materials engage students and support them in developing the skills, knowledge, and mindset they need to be successful in high school and beyond.

OpenSciEd was developed through collaboration between science educators, curriculum developers, science content experts, and researchers. It provides the support all students and teachers deserve.

- Anchoring phenomena explored through diverse interdisciplinary contexts serve as the foundation for compelling, coherent storylines.

- Research-based multimodal learning allows students to develop expertise in all Science and Engineering Practices (SEPs) and a deep understanding of Disciplinary Core Ideas (DCIs) and Crosscutting Concepts (CCCs).
• Simulations and data visualization tools enable students to create and refine models of their ideas of key scientific phenomena.

• Embedded engineering in units focused on problem-solving and technology emphasize that there is not always one right answer, as students balance competing constraints to design the best justifiable solutions.

• Developed utilizing Universal Design for Learning principles to support a diverse student population and emerging multilingual learners.
Middle School Science Course

6th Grade

Unit 6.1 Light & Matter
Anchoring Phenomenon: One-way mirror
Instructional days: 18
Domain: Physical, Life

Unit 6.2 Thermal Energy
Anchoring Phenomenon: Insulated cups
Instructional days: 37
Domain: Physical, Engineering

Unit 6.3 Weather, Climate, & Water Cycling
Anchoring Phenomenon: Hailstorms, large weather system
Instructional days: 42
Domain: Earth & Space, Physical

Unit 6.4 Plate Tectonics & Rock Cycling
Anchoring Phenomenon: Earthquake
Instructional days: 26
Domain: Earth & Space

Unit 6.5 Natural Hazards
Anchoring Phenomenon: Tsunami
Instructional days: 21
Domain: Earth & Space, Physical, Engineering

Unit 6.6 Cells & Systems
Anchoring Phenomenon: An injury
Instructional days: 25
Domain: Life
7th Grade

Unit 7.1 Chemical Reactions & Matter
Anchoring Phenomenon: A bath bomb in water
Instructional days: 25
Domain: Physical, Life

Unit 7.2 Chemical Reactions & Energy
Anchoring Phenomenon: Heating food in an emergency
Instructional days: 21
Domain: Physical, Engineering

Unit 7.3 Metabolic Reactions
Anchoring Phenomenon: M’Kenna’s illness
Instructional days: 29
Domain: Life, Physical

Unit 7.4 Matter Cycling & Photosynthesis
Anchoring Phenomenon: Food from plants
Instructional days: 29
Domain: Life, Physical

Unit 7.5 Ecosystem Dynamics & Biodiversity
Anchoring Phenomenon: Chocolate that impacts animals
Instructional days: 33
Domain: Life, Earth & Space, Engineering

Unit 7.6 Earth’s Resources & Human Impact
Anchoring Phenomenon: Extreme floods or droughts
Instructional days: 33
Domain: Earth & Space, Engineering
8th Grade

Unit 8.1 Contact Forces
Anchoring Phenomenon:
Dropped phone that breaks
Instructional days: 29
Domain: Physical, Engineering, Life

Unit 8.2 Sound Waves
Anchoring Phenomenon:
Sound that makes something move
Instructional days: 24
Domain: Physical, Life

Unit 8.3 Forces at a Distance
Anchoring Phenomenon:
Moving things from a distance
Instructional days: 30
Domain: Physical

Unit 8.4 Earth in Space
Anchoring Phenomenon:
Patterns in the sky
Instructional days: 31
Domain: Earth & Space, Physical

Unit 8.5 Genetics
Anchoring Phenomenon:
Big muscled animals
Instructional days: 28
Domain: Life, Earth & Space, Engineering

Unit 8.6 Natural Selection & Common Ancestry
Anchoring Phenomenon:
Ancient giant penguins
Instructional days: 32
Domain: Earth & Space, Engineering

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Middle Grades Scope & Sequence

The OpenSciEd Middle School Program is organized around units that each target a bundle of performance expectations. The program is sequenced to enable units to build on what students have developed in prior units while supporting the development of the three dimensions of NGSS, disciplinary core ideas (DCIs), crosscutting concepts (CCCs), and science and engineering practices (SEPs) coherently across the program. This coherence allows for presenting the concepts in a way that makes sense to students. Materials were designed to motivate student learning and help students see science as more connected to their lives. The tables below show the DCI bundling and the progression summary for the SEPs and CCCs across the units. Access the complete Scope and Sequence document with additional detail from our website.

Disciplinary Core Idea (DCI) Bundling and Connections

![Diagram of DCI Bundling and Connections]

Updated 1/23/2022

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OpenSciEd.org
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### Focal Crosscutting Concepts (CCCs) by Unit

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- ○ Not a Focus

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11
Comprehensive Suite of Materials

Each OpenSciEd unit is a comprehensive set of materials designed to be educative for teachers and engaging for students. Each unit has unit-level materials and lesson-level materials for teachers and students.

Program Structure

| Units | There are six units per grade, ranging between 18-41 instructional days each. Units are designed for students to fully explore an anchoring phenomenon and follow a coherent, sequenced storyline to support three-dimensional learning. Units within a grade level should be completed in order. |
| Lesson Sets | Each lesson set advances the storyline by investigating one aspect of the anchoring phenomenon through an inquiry cycle. Students complete relevant OpenSciEd Routines (Anchoring Phenomenon, Investigation, Putting the Pieces Together, Problematizing, or Navigation) to end the Lesson Set with a more complete or sophisticated understanding of the phenomena. |
| Lessons | Range in length from one 45 minute class period to several and have parts or activities that work together to help students make sense of a phenomenon or problem. Each lesson’s structure is determined by its OpenSciEd Routine and placement in the storyline. |

Example unit structure from Unit 6.5 Natural Hazards

Driving question: Where do natural hazards happen and how do we prepare for them?

Lesson 1: What causes tsunamis and other natural hazards to form, and how can we predict which communities are at risk?

Lesson 2-4: Students investigate where tsunamis happen, how they form, how they move, and who is at risk.

Problematize: Now that we know who is at risk, what can we do to mitigate the effects of tsunamis?

Lesson 5-8: Students investigate structural, technological, and communication systems designed to protect communities.

Lesson 9: Students apply science and engineering ideas in a culminating project on another hazard.
Unit Overview Information for the Teacher

- **Unit Overview Page** – An overview of the unit, the phenomena or problems addressed, and the NGSS Performance Expectations the unit builds toward.

- **Unit Storyline** – A lesson-by-lesson summary of the unit with the lesson question, phenomena or design problem, what we do and figure out and how we navigate to the following lesson.

- **Teacher Background Information** - Detailed information about the unit including the NGSS Dimensions developed, the structure of the unit and placement in the Scope and Sequence, how the unit supports equitable science learning, and other supportive topics.

- **Home Communication** - A sample letter for parents/guardians about the unit to be sent home with students at the launch of the unit.

- **Guidance for Developing your Word Wall** - Guidance on vocabulary development within the unit, including word lists, procedures, and supports for emerging multilingual learners.

- **Assessment System Overview** -
  - **Overall Unit Assessment Table** - Each OpenSciEd unit includes an assessment system that offers many opportunities for different types of assessments throughout the lessons. This table outlines where each type of assessment can be found in the unit and the purpose of the assessment.
Lesson-by-Lesson Assessment Opportunities - Summarizes opportunities in each lesson for assessing three-dimensional learning. Every lesson has a lesson-level performance expectation (LLPE), a three-dimensional learning expectation, combining elements of science and engineering practices, disciplinary core ideas, and crosscutting concepts.

Additional Unit Information for the Teacher
The following items are included in the unit folder when it is downloaded from OpenSciEd.org.

- **Elements of the NGSS Dimensions** - This document summarizes how the elements of the focal Science and Engineering Practices and Crosscutting Concepts are addressed in each lesson.

- **Unit Materials List** - Each unit has a lab materials list for the unit as a whole, which is described in the unit-level section. The list describes the materials a teacher would need to teach six sections of 30 students grouped into small groups of 4 students. A PDF version of the unit material list is included in the downloadable folder for each unit. The unit list of materials is also available in a more interactive format on each unit’s page at [https://www.openscied.org/access-the-materials/](https://www.openscied.org/access-the-materials/).

- **General OpenSciEd Resources**
  - **Teacher Handbook** - Provides overviews of features of the OpenSciEd units and resources that are likely to be new to many teachers. Each chapter focuses on a different feature.
  - **Teacher Resources and Tools** - Provides a collection of all OpenSciEd tools and resources that can be used and customized for other units. This document is organized into clusters of resources.
  - **Professional Learning Materials** - There are six different professional learning sessions that support the classroom materials, starting with the Curriculum Launch. All the professional learning resources are Open Educational Resources (OER) so they can be downloaded, adapted, and shared.
# Lesson Level Materials

Each lesson includes

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<thead>
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<th>Lesson-Level Teacher Edition</th>
<th>Slides</th>
<th>Teacher References</th>
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<td><img src="image" alt="Slide" /></td>
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<th>Handouts</th>
<th>Student References</th>
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<th>Videos</th>
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Teacher Materials:
- **Teacher Edition** - Described in detail below
- **Slides** - Each lesson has an editable set of presentation slides and google docs that teachers can project and use as they move through each lesson.
- **References, Rubrics, and Keys** - Additional lesson resources, such as lab instructions, keys, and rubrics, as appropriate for the lesson.

Student Materials:
- **Handouts** - These include readings, references, and handouts
- **Assessments** - Each unit has a comprehensive assessment system with embedded formative and summative assessments
- **Interactive resources** - Students utilize simulations, videos, and interactive data visualizations as they are figuring out science ideas.

**Teacher Edition - Lesson-Level**
The Teacher Edition has five different components for each lesson.
1. **Lesson Overview**
2. **Learning Plan Snapshot**
3. **Materials List & Preparation**
4. **Where we are Going and NOT Going**
5. **Learning Plan**
1. Lesson Overview

Lesson type and length

Lesson question

How the lesson fits in with the storyline

3-D Lesson-Level Performance Expectations

What students will figure out

NGSS Performance Expectations the unit builds toward

2. Learning Plan Snapshot

Lesson Plan Part & Duration

Summary

Corresponding Slides

Lab & Other Materials Needed

Day Breaks (assuming 45 min days)
3. Materials List & Preparation

### Lesson 2 - Materials List

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<td>blank Science Ideas chart on chart paper</td>
<td></td>
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</tr>
<tr>
<td>Self-Documentation Collection (on chart paper or the classroom bulletin board or digital space)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Related Phenomena chart (from Lesson 1)</td>
<td></td>
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<tr>
<td>sticky notes</td>
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</tr>
</tbody>
</table>

**Italicized items are handouts to be printed or digitally accessed.**

**Materials preparation (45 minutes)**

Review teacher guide, slides, and teacher references or keys (if applicable).

Make copies of handouts and ensure sufficient copies of student references, readings, and procedures are available.

**Day 1: Light Switch Investigation**

**Group size:** 6 students per group, depending on class size.

**Setup:**
- Check batteries in flashlights and replace as needed.
- If not done previously, modify each box model by using a box cutter to cut a flashlight hole in the top of Room B
- Place cardboard to cover the flashlight hole in the top of Room A.
- Slide picture mat set with one-way mirror film into the cardboard.

**Storage:**
- Find a location where you can stack the box models to the side of the classroom.

**Day 2**

If your students are using line of sight models in Lesson 1 and day 1 of this lesson, be prepared to insert one or more of the Prerequisite Understanding Activities during the Building Understandings Discussion. Note: Some of these activities require a group size of 6 students per group.

**Activity 1: Tracing the Path of Light with a Flashlight and Laser**

- 1 laser pointer (optional)
- 1 flashlight (adjustable zoom to focus light in tighter beam, high powered)
- 1 sheet of paper or cardboard
- chalk dust or flour
- small mirror
- chart paper or whiteboard

**Approximate Preparation Time Needed**

**Preparation grouped by italicized names of each investigation**

**Group size guidance, setup and materials storage provided**
4. Where We Are Going and NOT Going
Each lesson has a section that describes the lesson's focus and where the lesson is deliberately not going. The boundaries exist because they were defined by the NGSS standards, meaning the content is either below or above grade level, or it could be that the content will be addressed in a future lesson or future unit. This section helps teachers understand what to focus on and listen for as part of the lesson.

5. Learning Plan
This section has detailed guidance for teaching the lesson. It is broken up by Lesson Part, which aligns with the parts in the Lesson Snapshot. Learning Plans are comprehensive, including example questions to ask at particular points in the lesson and example student responses. These guides are not intended to be used as a script but rather as suggestions for implementing the lessons, which teachers can start with in planning instruction for their specific settings and students.
Embedded within the Learning Plan are callout boxes with supports on the following topics:

- Assessment Opportunity Guidance
- Attending To Equity
- Supporting Emerging Multilingual Learners
- Supporting Universal Design for Learning
- Strategies for Facilitating Discussion
  - Initial Ideas Discussion
  - Building Understandings Discussion
  - Consensus Discussion
- Home Learning Opportunity
- Safety Precautions
- Supporting Students in
  - Engaging in the Focal Science & Engineering Practices
  - Developing and Using the Focal Crosscutting Concepts
  - Three-Dimensional Learning
  - Making Connections In English Language Arts
  - Making Connections In Mathematics
  - Writing In Science
  - Utilizing a Science Notebook
  - Collaboration

Below are a few callouts from Unit 6.1 Light and Matter.

**ASSESSMENT OPPORTUNITY**

Building towards 2.A Ask questions that can be investigated in the classroom and frame a hypothesis about what we will see from both sides of the box model if we change the amount of light on either side of the box model (structure).

What to look/listen for: (1) Questions that focus on changing one aspect of the light in the box model at a time, (2) questions that are feasible in terms of time and materials, and (3) hypotheses framing what students expect to see.

What to do: Focus on helping students consider changes they could make to the structure of the box model specific to the light. Press them to explain why they think their questions are feasible to investigate in the classroom. Point them back to the box model to help them evaluate the ease with which some of their questions could be investigated given limitations of the materials on hand.

**ATTENDING TO EQUITY**

The gallery walk will support students in collectively making sense of these phenomena. It also presents an opportunity to practice the norm of "Moving our science thinking forward" as we work together to figure things out. Encourage students to be open to changing their minds if they see a good idea from someone else. Highlight norms from this category:

- We use and build on other's ideas.
- We are open to changing our minds.
- We challenge ourselves to think in new ways.

**SUPPORTING STUDENTS IN ENGAGING IN ASKING QUESTIONS AND DEFINING PROBLEMS**

An important aspect of supporting students to ask testable questions is to help them consider what is feasible to investigate, particularly in terms of being able to gather evidence. While students likely have many questions they want to pursue, focus them on what is feasible in the classroom in terms of available resources and amount of time.

**SUPPORTING STUDENTS IN DEVELOPING AND USING STRUCTURE AND FUNCTION**

Emphasize that students are changing the structure of the box model by changing the location of the light. Point out that their questions are about how the one-way mirror will function differently given the change to the light.
Instructional Supports

Embedded in the OpenSciEd units are instructional supports that allow educators to provide a more holistic educational experience for students. They include support for assessing student learning and instructional differentiation for learners with a variety of needs.

Support for Assessing Student Learning

OpenSciEd has developed an assessment system grounded in the recommendations of the National Research Council (2014) report, Developing Assessments for the Next Generation Science Standards. An assessment system is a holistic way that supports teacher autonomy and multiple ways for students to demonstrate their ability to reason with the three dimensions. The OpenSciEd assessment system has five different kinds of assessment embedded in the unit: formative, summative, pre-assessment, self-assessment, and peer-assessment. Each unit’s key assessment moments are listed in the Assessment Overview Table and the necessary materials and associated keys. You can find the Assessment Overview Table in the Unit Overview document for the digital version or at the end of the printed Teacher Editions.

Assessment Across an OpenSciEd Unit
Supports for Differentiation

OpenSciEd units are designed with Universal Design for Learning principles to provide equitable and accessible learning from the outset of the units. By making supports available for all students, equitable and accessible design can reduce the need for more nuanced differentiation in varying contexts. But, we acknowledge that teachers will still need to find ways to accommodate activities in the materials to better fit with student learning needs or the needs and resources of the classroom.

There are many ways differentiation occurs in classroom settings. OpenSciEd units are also designed with differentiation in mind, allowing teachers to adapt the materials as necessary without diminishing the learning experiences for students.

OpenSciEd units specifically include differentiation strategies in the following sections of the units: Teacher background knowledge, the lesson-level “Where we are going” and “Where we are not going” sections, and the assessment overview and guidance tables. These sections provide teachers with information about adapting the lessons’ content, process, or product. Teachers can also find differentiation guidance within the Learning Plans in three particular types of callouts:

- **Equity** - Focus on moments in instruction in which a certain population may benefit from a particular strategy, for example, supporting language development for emergent multilingual learners, providing extended learning opportunities or readings for students with high interest, providing specific strategies for students with special learning needs.

- **Alternate Activity** - Provide guidance to teachers about going further or streamlining activities based on student progress and/or completing different learning activities. These can be particularly helpful for students with high interest or for students or classrooms that need to modify the unit based on the availability of time or access to resources.

- **Additional Guidance** - Provide more specific instructions to teachers about making a learning activity successful based on their students’ needs. The callout boxes offer a variety of instructions to modify the timing, grouping, or resources for a particular activity.
Supporting Emerging Multilingual Learners (EMLs)

There are two primary ways that OpenSciEd supports Emerging Multilingual Learners (EMLs):

1. through the curricular design and pedagogical routines that are at the heart of its instructional model, and
2. through educative boxes embedded in the teacher materials.

The curricular design and routines of OpenSciEd grounds students’ learning experiences in real-world phenomena. For instance, a 6th grade unit on thermal energy is anchored in students figuring out - how can containers keep stuff from warming up or cooling down? In this approach to science learning, students are not just memorizing science ideas or “facts” about energy transfer. Instead, they are working with peers to figure out their own understanding and design solutions for interesting problems in the world. When the phenomena being explored are relevant and accessible, EMLs can better contribute and build from their previous understandings about the phenomena.

OpenSciEd teacher materials also include callouts focused on EMLs, often appearing as supplemental text on the margins of lesson plans. These educative boxes support teachers in considering whether particular learning moments might be spaces where they can leverage their EMLs’ assets and/or address potential challenges their students might encounter. These educative boxes help teachers provide additional in-time support and explain why these instructional moves are important for EMLs. They also range greatly, from suggesting particular ways to group students to unpacking the meaning of certain words in the context of science.
Supports for Remote Learning

Louisiana, one of OpenSciEd's partner states, has modified many of our units for a remote learning environment. In partnership with teachers, the Louisiana Department of Education arranged OpenSciEd content to stay true to the vision of the materials and provide clear guidance on how to use them in a fully remote environment. Since all OpenSciEd materials are Open Educational Resources, all educators can utilize their thinking and modify it for their learning environment.

These adapted materials do not omit lessons from the OpenSciEd units. The modified materials assume that teachers will have synchronous virtual meetings with students in addition to home learning. Examples of specific interactive platforms to support synchronous virtual meetings are provided, which can be adapted to the tools available in your district. This guide is intended as a supporting document and should be used in conjunction with the unit's Teacher Edition.

In addition to the Remote Learning Adaptations, we have developed a series of resources to support teachers with moving their instruction to a remote setting. The resources linked below contain detailed information about adapting the OpenSciEd routines to a remote learning environment. They also provide a variety of approaches to remote learning, including options for students who do not have internet access.

Fostering Productive Norms
Anchor Phenomenon Routine
Navigation Routine
Supporting Discourse
Problematizing Routine
Resources for Adult-Level Learning

The OpenSciEd instructional model focuses on the teacher being a member of the classroom community, supporting students to figure out scientific ideas motivated by their questions about phenomena. Students iteratively build their understanding of phenomena as the unit unfolds. To match the incremental build of a full scientific explanation across a unit, the science content background necessary for teachers to teach individual lessons builds incrementally. Throughout each unit, we provide just-in-time science content background specific to the Disciplinary Core Ideas (DCIs) that are figured out in a lesson. Places to look for this guidance include the “Where we are going” and “Where we are not going” sections for each lesson. Additionally, the expected student responses, keys, and rubrics have illustrated important science ideas that should be developed in units. In addition, we recommend the following science content resources for teachers to consult:


- Paul Anderson at Bozeman Science has produced additional informational videos on the NGSS Dimensions:
  http://www.bozemanscience.com/next-generation-science-standards
The OpenSciEd Curriculum

How to Access the Materials

OpenSciEd materials are available free at OpenSciEd.org. They can be viewed or downloaded as PDF files or Google Docs to view or copy. The videos, interactive models, and other assets needed for each unit are also available on our website.

Because these are Open Educational Resources and licensed as CC BY 4.0, our materials are free to use, modify and distribute with attribution. As a result, the materials are available for download or purchase from various sources. We have developed partnerships with a small number of publishers who have gone through the process of becoming Certified Distributors. As part of this certification, we have reviewed their version of our materials to ensure quality at the curriculum and kit level. You can learn more about the Certified Distributors and how we work with these partners on our website.

Lab Investigation Kits

We believe that students should directly experience scientific phenomena as part of their science learning. Complete lists of materials for creating the phenomena in your classroom are available within the teacher materials and on our website here https://www.openscied.org/access-the-materials/. Teachers can assemble their own materials or can purchase certified kits from our partners, listed on the website.

Professional Learning

Free Online Resources - Our curriculum-based professional learning leverages OpenSciEd’s award-winning materials to help teachers reach and engage every student in science learning. There are six different professional learning sessions that support the classroom materials, starting with the Curriculum Launch. All our professional learning resources are Open Educational Resources (OER) so you can easily download, adapt, and share.

Professional Learning Services - Transformative professional learning is available directly from OpenSciEd or certified providers. Our team helps you determine what support is needed based on teacher and district needs. We adapt our professional learning to meet your teachers where they are at and move them forward. Our team will provide learning experiences that accommodate your preferred learning format: face-to-face, virtual.
(synchronous or asynchronous), or a hybrid of these formats. We can also provide support systems for continued learning and connect educators to a growing community of collaborative OpenSciEd educators.

**Facebook Groups** - Our teacher community actively supports each other through unit-specific Facebook groups moderated by classroom teachers with experience in implementing the units.