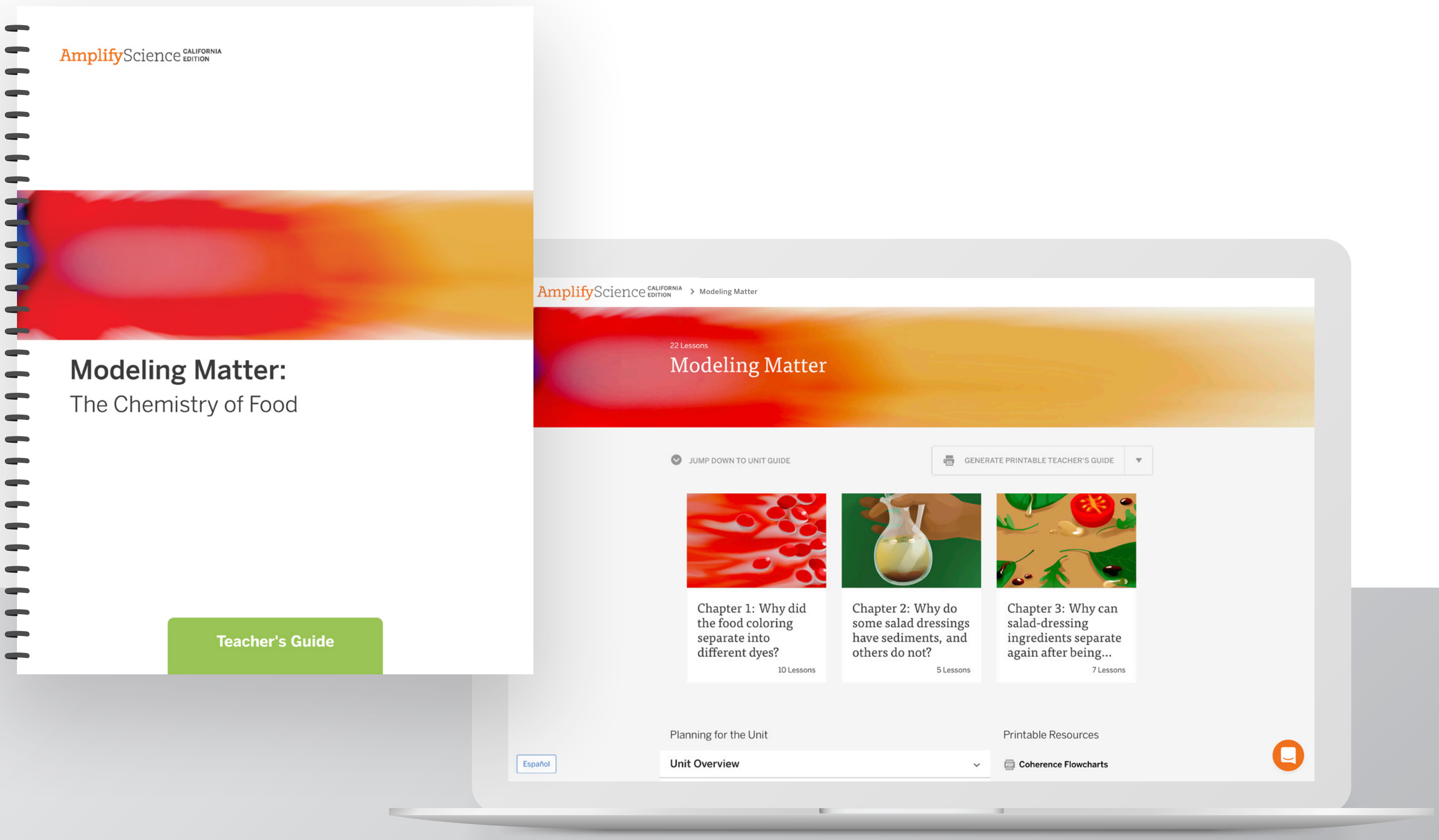
Amplify Science
CALIFORNIA

Grade 5

UNIT GUIDE

Modeling Matter



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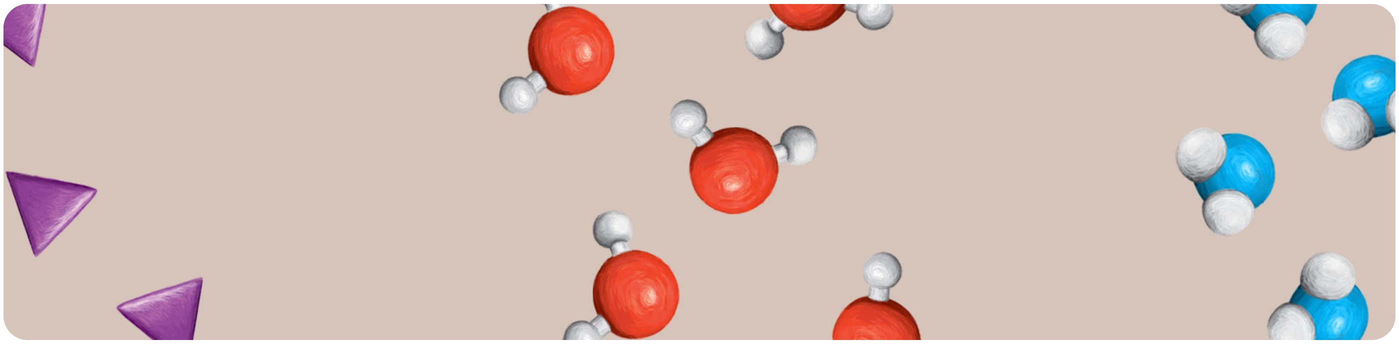


Welcome to Modeling Matter

The Next Generation Science Standards (NGSS) expect that students in grade 5 will be able to use a particulate model of matter to explain macroscale phenomena. This is very different from just expecting that students will know that matter is made of atoms and molecules, which is all that most standards and curricula have expected to date. In contrast, Amplify Science California ensures students get beyond rote learning of the particulate model of matter by providing them with opportunities to investigate different molecules with different characteristics, as well as discover the importance of nanoscale characteristics—shape, size, weight, and a molecule's attraction to other molecules.

> Unlike a typical curriculum, Amplify Science California anchors learning by inviting students to take on the role of scientists and engineers.

In this unit, students take on the role of food scientists. Their job is to help the CEO of a large fictional food production company solve two problems. The first is to identify a potentially hazardous food dye in a mixture. The second is to create a good-tasting and visually appealing salad dressing that does not separate into layers and contains no sediment. By the end of the unit, students explain what can happen when two substances are mixed, at both the observable scale and the nanoscale.

Unit Type: Modeling

Student Role: Food Scientists

Phenomenon: Chromatography is a process for separating mixtures. Some solids dissolve in a salad dressing while others do not. Oil and vinegar appear to separate when mixed in a salad dressing.

Core Concept: Understanding the connection between the observable properties of materials and the properties of the molecules of which those materials are composed

Target Performance Expectations:

- 5-PS1-1: Matter is Made of Particles
- 5-PS1-3: Properties of Materials
- 5-PS1-4: Mixing Substances

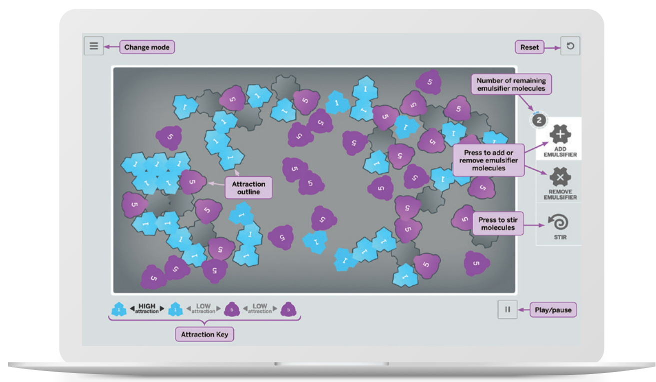
Students figure out the unit phenomenon through the use of a variety of resources.

Student Books

Hands-On Kit

Videos

Simulations



About technology in this unit:
Amplify Science California gives you the flexibility to use technology in the way that meets your needs best. In 3–5, teachers have the option of using:

- **Student digital licenses** that allow for online completion of work, teacher feedback and grading, and digital class management.
- **Traditional consumable resources** that allow for a more familiar paper and pencil experience.

Whether students use the student digital experience or print workbooks, there are some technology-based activities all students will experience from time to time.

In grade 5, technology-based activities include Practice Tools and digital Simulations. In this particular unit, 7 of the 22 lessons incorporate the use of devices with 11% of the unit's activities involving the use of a digital tool.

When the use of a digital tool is called for in a lesson, teachers have several implementation options:

- **If limited student devices are available,** students can do activities in pairs or small groups.
- **If no student devices are available,** teachers can project the digital tool to the class and create a whole class experience.

Chapter 1:
The storyline begins

What students investigate:

Why did the food coloring separate into different dyes?

What they figure out:

The different dyes that are mixed together have different properties (colors), so they are made of different molecules. The molecules in the mixture that are carried up the paper by the water are attracted to the water and mix with it. As the water travels up the paper, different kinds of molecules travel different distances because their molecules are different sizes or have a different attraction to the paper.

How they figure it out:

- Learning that everything around them is made of tiny particles called atoms and that atoms joined together are called molecules as they read the student book *Made of Matter*
- Conducting a chromatography test on the dye mixture and observing as it separates
- Exploring and critiquing a variety of physical models before creating their own models of what might be happening at the nanoscale
- Considering the scientific importance of being able to separate mixtures along with various separation techniques as they read the student book *Break It Down: How Scientists Separate Mixtures*
- Sharing, critiquing, and revising their diagram models

KEY

- HANDS-ON
- MODELING
- READING
- SIM
- STUDENT-TO-STUDENT DISCUSSION
- TEACHER
- TEACHER-LED DISCUSSION
- WRITING

DAY 1 | LESSON 1.1

Pre-Unit Assessment

- Introducing the Unit (10 min)
- Students Write Initial Explanations (20 min)
- Introducing Investigation Notebooks (10 min)
- Providing the Context of Food Science (20 min)

Pre-Unit Assessment

DAY 2 | LESSON 1.2

Introducing Food Science

- Preparing to Investigate (10 min)
- Food-Mixture Investigations (30 min)
- Debriefing Properties of Food (20 min)

On-the-Fly Assessment

DAY 3 | LESSON 1.3

Made of Matter

- Introducing the Nanoscale (10 min)
- Previewing *Made of Matter* (10 min)
- Partner Reading (30 min)
- Discussing Models and Matter (10 min)

On-the-Fly Assessment

DAY 4 | LESSON 1.4

Separating a Food-Coloring Mixture

- Introducing the Harmful-Dye Context (5 min)
- Separating the Food Coloring (15 min)
- Making the Pasta Model (10 min)
- Discussing Chromatography Results (15 min)
- Writing About Molecules (15 min)

On-the-Fly Assessment

DAY 5 | LESSON 1.5

Exploring Another Model of Chromatography

- Reading the President's Emails (5 min)
- Thinking About Chromatography (15 min)
- Introducing the Fan Model (15 min)
- Reflecting on Fan Model and Properties of Molecules (15 min)
- Scientists Make Observations and Inferences (10 min)

On-the-Fly Assessment

DAY 6 | LESSON 1.6

Nanovision Models of Chromatography

- Preparing to Make Nanovision Models of Chromatography (5 min)
- Drawing Nanovision Models (15 min)
- Model Swap (15 min)
- Making Digital Nanovision Models (25 min)

On-the-Fly Assessment
Self-Assessment

DAY 7 | LESSON 1.7

Break It Down

- Readers Make Inferences (10 min)
- Partner Reading (35 min)
- Reflecting on the Book (15 min)

On-the-Fly Assessment

DAY 8 | LESSON 1.8

Evaluating Chromatography Models

- Reviewing Properties Used for Separation (20 min)
- Shared Listening About Fan Model (10 min)
- Evaluating Nanovision Models (25 min)
- Reflecting on Evaluations (5 min)

On-the-Fly Assessment

DAY 9 | LESSON 1.9

Revising Chromatography Models

- Word Relationships (20 min)
- Drawing Revised Nanovision Models (30 min)
- Considering an Audience (10 min)

Critical Juncture Assessment (1A)

DAY 10 | LESSON 1.10

Explaining Chromatography

- Beginning a Scientific Explanation of Chromatography (15 min)
- Writing Scientific Explanations (30 min)
- Sharing Writing (15 min)

Critical Juncture Assessment (1B)
Self-Assessment

Chapter 2: The storyline builds

What students investigate:

Why do some salad dressings have sediments, and others do not?

What they figure out:

Salad dressings with sediments contain solids that are not soluble; salad dressings without sediments contain soluble solids. The molecules of water and the molecules of different solids are different from one another. When a solid dissolves in water (it is soluble), it means that the molecules of the solid are attracted to water molecules. When a solid does not dissolve in water, it means that the molecules of the solid are not attracted to water molecules.

How they figure it out:

- Learning about four scientists from different fields who all think about scale in their work as they read the student book *Who Thinks About Scale?*
- Investigating solids that dissolve and solids that do not dissolve
- Exploring the difference between disappearing and dissolving as they read the student book *Solving Dissolving*
- Observing solids dissolving at the nanoscale in the Sim
- Creating their own diagram models

KEY

- HANDS-ON
- MODELING
- READING
- SIM
- STUDENT-TO-STUDENT DISCUSSION
- TEACHER
- TEACHER-LED DISCUSSION
- WRITING

DAY 11 | LESSON 2.1

Investigating Flavor Ingredients

- Introducing the Salad-Dressing Context (10 min)
- Flavor Ingredients Test (35 min)
- Debriefing Data (15 min)

DAY 12 | LESSON 2.2

Investigating Dissolving

- Introducing Dissolving at the Nanoscale (5 min)
- Figuring Out How to Use the Simulation (15 min)
- Using the Simulation to Learn About Dissolving (20 min)
- Creating Nanoscale Models of Dissolving (20 min)
- Reading About Scale (25 min)

DAY 13 | LESSON 2.3

Reading About Dissolving

- Discussing Models and Inferences (10 min)
- Reading *Solving Dissolving* (30 min)
- Observations and Inferences (10 min)
- Discussing Solubility (10 min)

On-the-Fly Assessment

DAY 14 | LESSON 2.4

Models of Solubility

- Discussing Solubility and Attraction (15 min)
- Modeling Dissolving (20 min)
- Writing Scientific Explanations of Solubility (25 min)

On-the-Fly Assessment
Self-Assessment

DAY 15 | LESSON 2.5

Making Sense of Solubility

- Reading More About Ingredients (15 min)
- Making Models of Mixing (25 min)
- Evaluating Explanations (20 min)

Critical Juncture Assessment

Chapter 3: Application to a new context

What students investigate:

Why can salad-dressing ingredients separate again after being mixed?

What they figure out:

When liquids do not mix together, they form layers. The A molecules and the B molecules are not attracted to one another, so they do not mix together. In addition to the level of attraction between A molecules and B molecules, A molecules have a level of attraction to other A molecules, and B molecules have a level of attraction to other B molecules. Liquid ingredients in a salad dressing separate after being mixed if the attraction between molecules of one liquid is greater than the attraction between molecules of different liquids. However, if an emulsifier is added, the liquids can mix because the molecules of the emulsifier are strongly attracted to both A molecules and B molecules.

How they figure it out:

- Exploring the work of three scientists who all study phenomena that cannot be directly observed as they read the student book *Science You Can't See*
- Observing real liquids that don't mix and then figuring out what the phenomenon might look like at the nanoscale in the Sim
- Creating their own models of mixing and non-mixing liquids
- Experimenting with food additives that act as emulsifiers in order to make liquids mix
- Exploring and observing how emulsifiers work at the nanoscale, and creating their own models that explain how emulsifiers work in the Sim

KEY

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- TEACHER
- TEACHER-LED DISCUSSION
- WRITING

DAY 16 | LESSON 3.1

Investigating Attraction

- Demonstrating Mixing Liquids (10 min)
- Testing Attraction (30 min)
- Debriefing Data (10 min)
- Introducing the All Aboard Model (10 min)

On-the-Fly Assessment

DAY 17 | LESSON 3.2

Science You Can't See

- Previewing *Science You Can't See* (10 min)
- Finding Evidence (35 min)
- Making Inferences (15 min)

On-the-Fly Assessment

DAY 18 | LESSON 3.3

Modeling Mixtures

- Discussing Liquid Mixtures (10 min)
- Investigating Molecules in Mixing (20 min)
- Revisiting the All Aboard Model (15 min)
- Revising Ideas Based on Evidence (15 min)

On-the-Fly Assessment

DAY 19 | LESSON 3.4

Investigating Emulsifiers

- Introducing Emulsifiers (5 min)
- Setting Up Stability Tests (20 min)
- Word Relationships (15 min)
- Debriefing Stability Tests (20 min)

Self-Assessment

DAY 20 | LESSON 3.5

Models of Emulsifiers

- Observing an Emulsifier (10 min)
- Drawing Nanovision Models of Emulsifiers (15 min)
- Exploring Emulsifiers in the Simulation (15 min)
- Using the Simulation to Model Salad Dressing (20 min)

On-the-Fly Assessment

DAY 21 | LESSON 3.6

Creating Digital Models of Emulsifiers

- Modeling Emulsifiers (20 min)
- Evaluating Models of Emulsifiers (20 min)
- Gathering Evidence About Ingredients (20 min)

On-the-Fly Assessment
Critical Juncture Assessment

DAY 22 | LESSON 3.7

End-of-Unit Assessment

- Reviewing Evidence (10 min)
- Writing Final Scientific Explanations (25 min)
- Taste-Testing the Salad Dressing (25 min)

End-of-Unit Assessment

All students. All standards.

Rather than treating the standards simply as a list of topics to cover, we designed Amplify Science California to allow for truly in-depth and integrated coverage of the disciplinary core ideas (DCIs), science and engineering practices (SEPs), and crosscutting concepts (CCCs). Unlike other programs, however, ours makes the NGSS' vision of "all students, all standards" a reality by creating a unit-specific learning progression for every unit called a Progress Build.

Each Progress Build defines several levels of understanding of the unit's anchoring phenomenon, with each level integrating and building upon the knowledge and skills from lower levels. In this way, each Progress Build provides a clear roadmap for how students' understanding of the phenomenon is expected to deepen and develop with each successive chapter and lesson.

What's more, the program's system of assessments is also tied to these Progress Builds. This carefully crafted integration provides teachers with credible, actionable, and timely diagnostic information about student progress toward the unit's learning goals and grade-level performance expectations. Armed with this powerful data, teachers have the ultimate flexibility to decide when to move on and when to slow down and dive deeper.

Modeling Matter Progress Build

The Progress Build in this unit consists of three levels of understanding. At each level, students add new ideas and integrate them into a progressively deeper understanding of how nanoscale interactions account for observable phenomena, such as a food-coloring mixture separating through chromatography and a salad dressing stabilized with an emulsifier.

Progress Build Level 1:
Observable properties result from molecular properties.

Progress Build Level 2:
Mixing is a result of attraction between molecules of different substances.

Progress Build Level 3:
Separation is a result of the attraction between molecules of the same substance.

Examples of differentiation in this unit

In addition to providing unit-specific Progress Builds that break learning goals into smaller, more achievable levels of understanding, Amplify Science California makes learning accessible for all students through a variety of scaffolds, supports, and differentiation strategies for every lesson. **For a complete list of strategies, see the Differentiation section of every Lesson Brief**.

Below are a few examples of strategies embedded in this unit.

For English learners:

Partner reading (Example from Lesson 2.5)
Reading with a partner provides opportunities for students to assist each other with reading—with using the reading strategy modeled by the teacher, locating information in the text, with decoding, and with comprehension. Partner Reading also encourages discussion of the text during reading, which aids understanding.

For students needing more support:

Anticipation Guide (Example from Lesson 3.2)
For each book, we provide an optional Anticipation Guide in the Investigation Notebook. Anticipation Guides can help support students by activating prior knowledge before reading, promoting engaged reading, and encouraging students to monitor their comprehension. If you choose to use this optional activity, have students turn to page 61, Getting Ready to Read: *Science You Can't See*, in the Investigation Notebook. To use this activity, explain that students should work with a partner to decide if they agree or disagree with each statement. After reading, ask partners to revisit the statements and discuss whether they want to change any responses based on their reading. Encourage students to refer to the text as they discuss.

For students ready for a challenge:

Write a summary of the test results (Example from Lesson 1.4)
Ask students who need more challenge to write comprehensive summaries, to accompany their diagrams, about what they discovered during the chromatography test. Encourage them to use the vocabulary words they have learned so far: atom, matter, mixture, model, molecule, observe, and substance.

3-D Statements

In order to help teachers recognize the three-dimensional structure of every unit, chapter, and lesson, each unit contains a 3-D Statement document that makes the integration clear.

Making the 3-D statement document all the more effective, the three dimensions are color-coded for easy recognition.

Modeling Matter 3-D Coverage

SEPs	DCIs	CCCs
Science and Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts

Unit Level

Students are introduced to the particulate model of matter (energy and matter) and apply it in their role as food scientists as they explain how to separate a food-coloring mixture and how to create a stable salad dressing (stability and change). They do this by making firsthand observations of a variety of macroscale phenomena involved in separating and creating mixtures and then by creating diagram models and using physical and digital models to visualize what might be happening at the nanoscale (scale, proportion, and quantity).

Chapter Level

Chapter 1: Why did the food coloring separate into different dyes?

Students use physical models and create their own diagram models to investigate and communicate what is happening at the nanoscale during the process of chromatography (scale, proportion, and quantity). Through their investigations and models, students discover similarities and differences in the properties of substances and the properties of molecules (patterns).

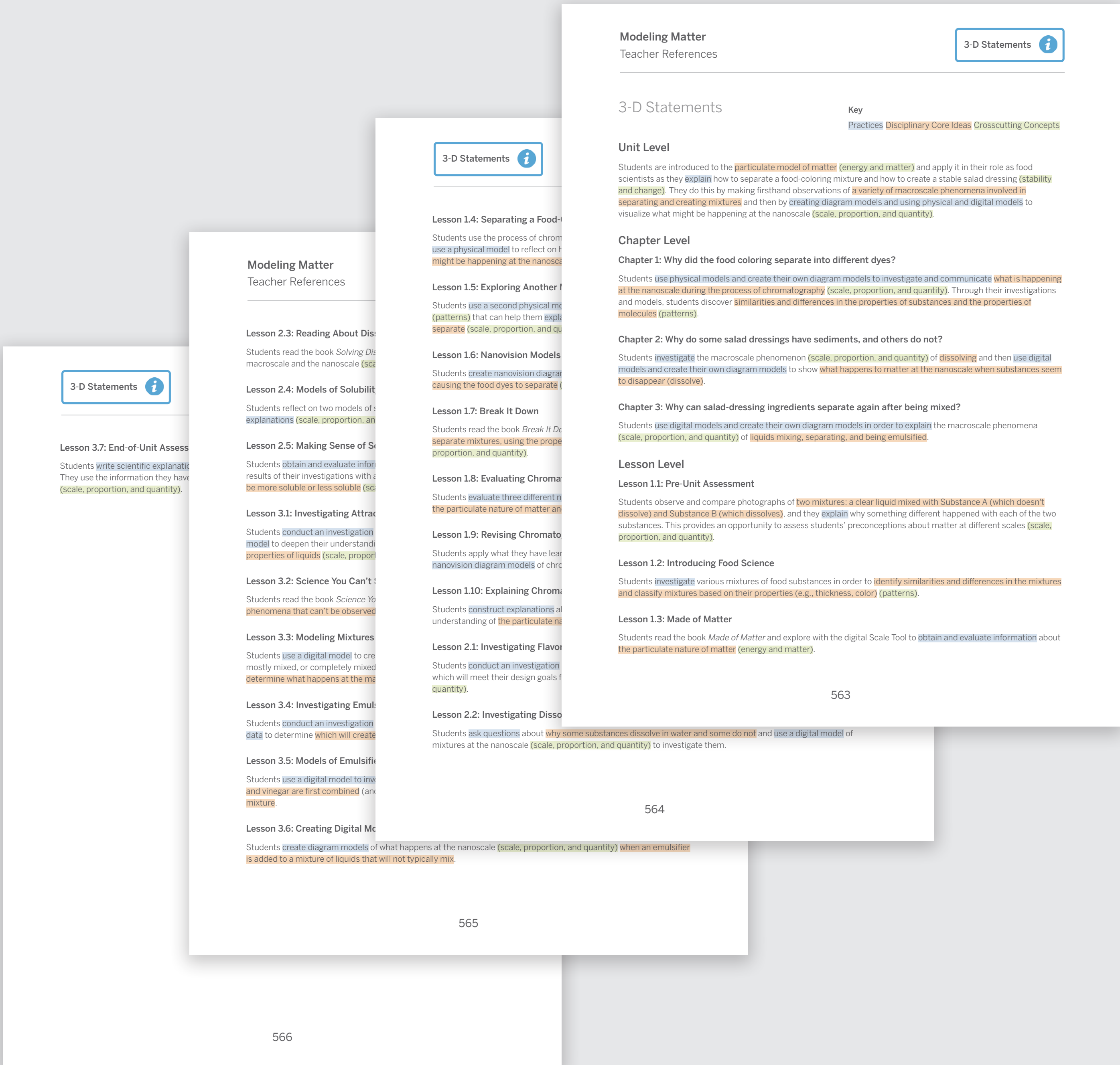
Chapter 2: Why do some salad dressings have sediments, and others do not?

Students investigate the macroscale phenomenon (scale, proportion, and quantity) of dissolving and then use digital models and create their own diagram models to show what happens to matter at the nanoscale when substances seem to disappear (dissolve).

Chapter 3: Why can salad-dressing ingredients separate again after being mixed?

Students use digital models and create their own diagram models in order to explain the macroscale phenomena (scale, proportion, and quantity) of liquids mixing, separating, and being emulsified.

To review the 3-D Statements at the lesson level, see the Lesson Brief section of every lesson.



Modeling Matter
Teacher References

3-D Statements

3-D Statements

Key
Practices Disciplinary Core Ideas Crosscutting Concepts

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Lesson Level

Lesson 1.1: Pre-Unit Assessment

Students observe and compare photographs of two mixtures: a clear liquid mixed with Substance A (which doesn't dissolve) and Substance B (which dissolves), and they explain why something different happened with each of the two substances. This provides an opportunity to assess students' preconceptions about matter at different scales (scale, proportion, and quantity).

Lesson 1.2: Introducing Food Science

Students investigate various mixtures of food substances in order to identify similarities and differences in the mixtures and classify mixtures based on their properties (e.g., thickness, color) (patterns).

Lesson 1.3: Made of Matter

Students read the book *Made of Matter* and explore with the digital Scale Tool to obtain and evaluate information about the particulate nature of matter (energy and matter).

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