Lesson 3.2
Science You Can’t See
Students read *Science You Can’t See*, a book about three scientists who make inferences in their work, since they study phenomena that cannot be observed directly. Students use these examples to think more broadly about why making inferences is necessary in science. They discuss the three topics studied by the scientists in the book—dinosaurs, the ocean floor, and magnetic atoms—by identifying the evidence that the scientists used and the inferences they made. Students then go on to make their own inferences based on evidence from the text. The purpose of this lesson is for students to extend their practice of making inferences when reading and to broaden their understanding of the need for making inferences based on evidence in science, particularly with things that cannot be directly observed.

**Anchor Phenomenon**: A salad dressing has sediments and layers.

**Students learn**:

- Many scientists study things that can’t be seen by making inferences based on evidence.
- Science findings are based on recognizing patterns.
- Science theories are based on a body of evidence and many tests.
- Men and women from all cultures and backgrounds choose careers as scientists and engineers.
- Science is a way of knowing that is used by many people.
Students preview the book *Science You Can’t See* and the topics that the three featured scientists study.

### Instructional Guide

1. **Remind students of the Investigation Question.** Refer to the Investigation Question on the board and remind students that they are investigating what happens to the molecules of two liquids when you mix them together.

   We can’t see molecules, so we have to make inferences about what is happening to them, just as we have been doing for the past several lessons.

2. **Introduce book.** Hold up a copy of *Science You Can’t See*.

   This book is about three scientists who study things they can’t see and the inferences they make based on evidence. Before you read, take a few minutes to preview the headings, the images, and the captions in the book in order to find out more about these scientists and the topics they study.

3. **Distribute books.** Distribute one copy of *Science You Can’t See* to each pair of students. Give students time to preview the book.

4. **Preview each scientist’s work.** Have students look back at the headings, images, and captions in each section and think about each scientist. Ask students to explain their answers for each question you ask, referring back to the text as much as possible.

   - **Karen Chin’s work.**

     Why does she need to make inferences about dinosaurs?
     [Dinosaurs aren’t living anymore. They are extinct.]
What might she use for evidence?  
[Fossils, dinosaur droppings.]

- Edward Saade’s work.

Why does he need to make inferences about the bottom of the ocean?  
[It’s too hard to get to. It’s very deep.]

What evidence does he use to make inferences?  
[Data he collects from boats, maps, bouncing sound waves off the ocean floor.]

- Farid El Gabaly’s work.

Why does he need to make inferences about atoms?  
[Atoms are too small to see.]

What might he use for evidence?  
[Images from a microscope.]

Let students know that they will find out more by reading.

Teacher Support

Instructional Suggestion

Providing More Experience: Today’s Daily Written Reflection

Why do scientists evaluate models? This prompt (on page 60 in the Investigation Notebook) encourages students to connect their own experiences with evaluating models to the work of scientists. It builds on a similar question from earlier in the unit. When reading over students’ responses, try to gauge their understanding of the benefits of critiquing and evaluating models. Look for explanations of how scientific understanding is furthered by closely examining the attributes of different models and noting whether the models match students’ evidence and what they already know.

Background

Literacy Note: About the Book

Science You Can’t See introduces students to the work of three scientists, each of whom studies a phenomenon that cannot be observed directly. Karen Chin studies dinosaurs, Edward Saade investigates the ocean floor, and Farid El Gabaly uses an electron microscope to make images of atoms. In order to answer their questions, these scientists must make inferences based on evidence rather than direct observations. Science You Can’t See models an important aspect of the nature of science for students—making sound inferences based on evidence.
Instructional Suggestion

Supporting Discussions: Making Inferences in Reading
The reading focus in this lesson is on making inferences based on text in the book. Careful attention to details in the text, in combination with students' background knowledge, helps them answer the questions and identify some of the same conclusions that the scientists in *Science You Can’t See* made based on evidence they’ve collected. Throughout the lesson, encourage students to think about why they make particular inferences and help them identify the information they used to help them understand the concepts in the book.
Partners read the book, section by section, and identify inferences they can make about the work of each scientist.

**Instructional Guide**

1. **Introduce gathering evidence to make inferences.**
   - We will read to find the evidence that helped each scientist make inferences. We will read about the first scientist together. Then, you will read about the others with your partner.

2. **Read pages 4–5 with the class.** Read the first two pages of the book as a class and discuss as needed. Make sure students understand the premise of the book—scientists often gather evidence about things that are not directly observable.

3. **Partners read pages 6–10.** Have students read the “We Can’t See a *Tyrannosaurus Rex*” section with their partners. Ask them to think about what they are learning and understanding about dinosaurs as they read.

4. **Discuss Karen Chin’s work on pages 8–9.** When most students have finished reading the section, regain their attention.
   - We were correct that Karen has to make inferences because dinosaurs are extinct. Where does it say this? [Page 6. They have all been dead for millions of years.]
   - What evidence did Karen collect? Where did you read this? [Coprolites, which are fossil dinosaur droppings. On page 8.]

5. **Project notebook pages and model answering the questions in the first section.** Project the notebook onto the board or a whiteboard. Have students turn to pages 62–63, Evidence and Inferences in *Science You Can’t See*, in their notebooks. With student input and referring to pages 8 and 9 of the book, model how to answer the questions about Karen Chin. Read aloud the questions.
   - Karen Chin is investigating the question *How and what did dinosaurs eat?* What evidence did she use to help answer her question?
Write “She studied the coprolite. It was huge. It was found in Canada. It had dinosaur bones in it.”

What inferences did she make based on that evidence?

Write “The coprolite came from a T. rex. The T. rex ate other dinosaurs.”

6. **Partners read independently and continue making inferences.** Have partners read the next two sections—“We Can’t See the Deep Ocean Floor” (on pages 11–15) and “We Can’t See Atoms and Molecules” (on pages 16–23)—and stop to make inferences after each section. Remind students to think about evidence that scientists gathered and from prior knowledge in order to make inferences. Encourage partners to discuss as they read.

**Teacher Support**

**Rationale**

**Literacy Note: Suggested Approach to Reading**
In this lesson, students read each of the three sections of the book with a partner. After doing the first example as a class, partners will continue to read, stopping after each section to discuss what they read and recording evidence and inferences in their notebooks. If you think your students need more support with comprehending the text or picking out evidence and inferences, you may choose to further scaffold the reading. You can lead a class discussion about the main ideas of each section and discuss the evidence that each scientist collected and the inferences he or she made.

**Background**

**Science Note: About Echo Sounding**
Echo sounding is a technique in which sound pulses are sent down from the surface of a body of water in order to measure the distance to the bottom. Scientists measure the time it takes for the sound pulse to reflect off the bottom and return to the surface. The speed of sound through water is calculated given the temperature and salinity of the water. These measurements are then used to calculate the distance from the surface to the bottom. Echo sounding allows scientists to map large areas of the sea floor. (Sonar is a general term for locating objects underwater by using sound waves. Echo sounding is a kind of sonar used for measuring depth.)

**Science Note: About Electron Microscopes**
Electron microscopes allow scientists to create images of objects that are much too small to see with a regular microscope. Electron microscopes use streams of electrons that are tiny compared to atoms. A computer creates an image based on how the electrons interact with the atoms in the material being investigated. Farid El Gabaly uses a very special kind of electron microscope that “spin-polarizes” the electrons (their magnetic fields are all lined up in the same direction). This allows him to detect the magnetic orientation of the atoms in the metal he is studying. There are only a few microscopes in the world with this capability.

**Rationale**

**Pedagogical Goals: Understanding the Nature of Science**
One goal set forth by the Next Generation Science Standards (NGSS) is for students to understand the nature of science as a discipline and how scientific knowledge develops over time. The NGSS calls out eight understandings
about the nature of science that are woven throughout the Amplify Science curriculum. This unit gives students an opportunity to experience the following three understandings: Scientific Knowledge Is Based on Empirical Evidence; Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena; and Science Is a Human Endeavor. In this lesson, the book *Science You Can’t See* illustrates the idea that science findings are based on recognizing patterns—since the three scientists cannot directly observe the phenomena they study, they have to recognize patterns in the data they do have and make inferences based on those patterns. In addition, the book illustrates the idea that science theories are based on a body of evidence and many tests. For example, the theory of plate tectonics, which is based on a wide variety of data and several types of scientific tests, helps Edward Saade understand the ocean floor data he studies. Finally, through images, *Science You Can’t See* also shows that men and women from all cultures and backgrounds choose careers as scientists and engineers.

### Possible Responses

**Investigation Notebook**

**Evidence and Inferences in *Science You Can’t See*** (pages 62–63)

**Karin Chin**

Her evidence was the size of the coprolite and that there were crushed bones of a smaller dinosaur in the dropping.

She made the inference that it came from a *T. Rex*. She found out the *T. Rex* ate other smaller dinosaurs.

**Edward Saade**

His evidence came from the echo sounder and measuring the temperature of the ocean.

He made inferences in order to make a map of how deep the ocean is in different places.

**Farid El Gabaly**

His evidence was the images made by electrons bouncing off the atoms.

He made the inference that magnetic cobalt atoms can clump together in groups.

**Choose one section to reread. Record an inference you made while reading.**

Answers will vary.
Evidence and Inferences in *Science You Can't See*

Karen Chin is investigating the question *How and what did dinosaurs eat?* What evidence did she use to help answer her question?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

What inferences did she make based on that evidence?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Edward Saade is investigating the question *How deep is the ocean floor in different places?* What evidence did he use to help answer his question?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

What inferences did he make based on that evidence?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
Evidence and Inferences in *Science You Can't See* (continued)

Farid El Gabaly is investigating the question *What patterns do magnetic atoms form in very small pieces of metal?*

What evidence did he use to help answer his question?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

What inferences did he make based on that evidence?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Choose one section to reread. Record an inference you made while reading.

What did you read in the text?
On page ________, I read that

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

What inference did you make based on what you read?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
Students preview the book *Science You Can’t See* and the topics that the three featured scientists study.

Instructional Guide

1. **Remind students of the Investigation Question.** Refer to the Investigation Question on the board and remind students that they are investigating what happens to the molecules of two liquids when you mix them together.

   No podemos ver las moléculas, así que tenemos que hacer inferencias acerca de qué les está sucediendo, tal como lo hemos estado haciendo durante las últimas lecciones.

2. **Introduce book.** Hold up a copy of *Science You Can’t See*.

   Este libro trata sobre tres científicos que estudian cosas que no pueden ver y las inferencias que hacen basándose en evidencia. Antes de que lean, tomen unos cuantos minutos para echar un vistazo rápido a los encabezados, las imágenes y las leyendas en el libro para averiguar más acerca de estos científicos y los temas que estudian.

3. **Distribute books.** Distribute one copy of *Science You Can’t See* to each pair of students. Give students time to preview the book.

4. **Preview each scientist’s work.** Have students look back at the headings, images, and captions in each section and think about each scientist. Ask students to explain their answers for each question you ask, referring back to the text as much as possible.

   - Karen Chin’s work.

   ¿Por qué necesita hacer inferencias sobre los dinosaurios? [Los dinosaurios ya no existen. Están extintos].
¿Qué podría usar como evidencia?
[Fósiles, heces de dinosaurios].

- Edward Saade's work.

¿Por qué necesita hacer inferencias sobre el fondo del océano?
[Es demasiado difícil llegar ahí. Es muy profundo].

¿Qué evidencia usa para hacer inferencias?
[Datos que recopila de botes, mapas, ondas de sonido que rebotan desde el piso oceánico].

- Farid El Gabaly’s work.

¿Por qué necesita hacer inferencias sobre los átomos?
[Los átomos son demasiado pequeños para verlos].

¿Qué podría usar como evidencia?
[Imágenes de un microscopio].

Let students know that they will find out more by reading.

Teacher Support

Instructional Suggestion

Providing More Experience: Today’s Daily Written Reflection
Why do scientists evaluate models? This prompt (on page 60 in the Investigation Notebook) encourages students to connect their own experiences with evaluating models to the work of scientists. It builds on a similar question from earlier in the unit. When reading over students’ responses, try to gauge their understanding of the benefits of critiquing and evaluating models. Look for explanations of how scientific understanding is furthered by closely examining the attributes of different models and noting whether the models match students’ evidence and what they already know.

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Finding Evidence

Partners read the book, section by section, and identify inferences they can make about the work of each scientist.

Instructional Guide

1. Introduce gathering evidence to make inferences.

   Leeremos para encontrar la evidencia que ayudó a cada científico a hacer inferencias. Leeremos sobre la primera científica juntos. Luego, leerán sobre los otros en parejas.

2. Read pages 4–5 with the class. Read the first two pages of the book as a class and discuss as needed. Make sure students understand the premise of the book—scientists often gather evidence about things that are not directly observable.

3. Partners read pages 6–10. Have students read the “We Can’t See a Tyrannosaurus Rex” section with their partners. Ask them to think about what they are learning and understanding about dinosaurs as they read.

4. Discuss Karen Chin’s work on pages 8–9. When most students have finished reading the section, regain their attention.

   Estábamos en lo correcto en que Karen tiene que hacer inferencias porque los dinosaurios están extintos. ¿Dónde dice esto? [Página 6. Todos ellos han estado muertos desde hace millones de años].

   ¿Qué evidencia recopiló Karen? ¿Dónde leyeron esto? [Coprolitos, que son fósiles de heces de dinosaurios. En la página 8].

5. Project notebook pages and model answering the questions in the first section. Project the notebook onto the board or a whiteboard. Have students turn to pages 62–63, Evidence and Inferences in Science You Can’t See, in their notebooks. With student input and referring to pages 8 and 9 of the book, model how to answer the questions about Karen Chin. Read aloud the questions.
Karen Chin está investigando la pregunta ¿Cómo y qué comían los dinosaurios? ¿Qué evidencia usó ella para ayudar a responder su pregunta?

Write “She studied the coprolite. It was huge. It was found in Canada. It had dinosaur bones in it.”

¿Qué inferencias hizo basándose en esa evidencia?

Write “The coprolite came from a T. rex. The T. rex ate other dinosaurs.”

6. **Partners read independently and continue making inferences.** Have partners read the next two sections—“We Can’t See the Deep Ocean Floor” (on pages 11–15) and “We Can’t See Atoms and Molecules” (on pages 16–23)—and stop to make inferences after each section. Remind students to think about evidence that scientists gathered and from prior knowledge in order to make inferences. Encourage partners to discuss as they read.

**Teacher Support**

**Rationale**

**Literacy Note: Suggested Approach to Reading**

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Possible Responses

Investigation Notebook
Evidence and Inferences in *Science You Can’t See* (pages 62–63)

Karin Chin
Her evidence was the size of the coprolite and that there were crushed bones of a smaller dinosaur in the dropping.

She made the inference that it came from a *T. Rex*. She found out the *T. Rex* ate other smaller dinosaurs.

Edward Saade
His evidence came from the echo sounder and measuring the temperature of the ocean.

He made inferences in order to make a map of how deep the ocean is in different places.

Farid El Gabaly
His evidence was the images made by electrons bouncing off the atoms.

He made the inference that magnetic cobalt atoms can clump together in groups.

Choose one section to reread. Record an inference you made while reading.
Answers will vary.
Evidencia e inferencias en Ciencia que no puedes ver

Karen Chin está investigando la pregunta ¿Cómo y qué comían los dinosaurios?
¿Qué evidencia usó ella que la ayudara a responder su pregunta?

_____________________________________________________________________
_____________________________________________________________________

¿Qué inferencias hizo con base en esa evidencia?

_____________________________________________________________________
_____________________________________________________________________

Edward Saade está investigando la pregunta ¿Qué tan profundo es el lecho marino en diferentes lugares?
¿Qué evidencia usó él que lo ayudara a responder su pregunta?

_____________________________________________________________________
_____________________________________________________________________

¿Qué inferencias hizo con base en esa evidencia?

_____________________________________________________________________
_____________________________________________________________________
Evidencia e inferencias en *Ciencia que no puedes ver* (continuación)

Farid El Gabaly está investigando la pregunta ¿Qué patrones forman los átomos magnéticos en piezas de metal muy pequeñas?

¿Qué evidencia usó él que lo ayudara a responder su pregunta?

__________________________________________________________________

__________________________________________________________________

¿Qué inferencias hizo con base en esa evidencia?

__________________________________________________________________

__________________________________________________________________

Escoge una sección para volver a leer. Apunta una inferencia que hiciste mientras leías.

¿Qué leíste en el texto?

En la página ________, leí que

__________________________________________________________________

__________________________________________________________________

¿Qué inferencias hiciste con base en esa evidencia?

__________________________________________________________________

__________________________________________________________________