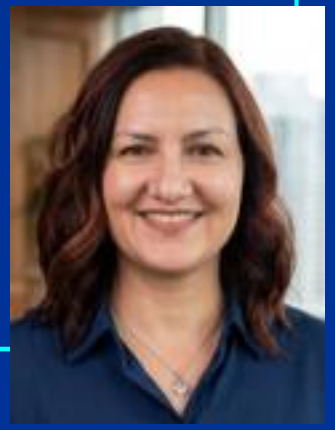
CAROLINA
UNLEASH LEARNING™

CAROLINA® + Smithsonian | STC Science and Technology Concepts™ Middle School

Science and Engineering Practices in Action with STCMS

Featuring New Haven Public Schools Spotlight Educators & Scholars



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SEPs in Action

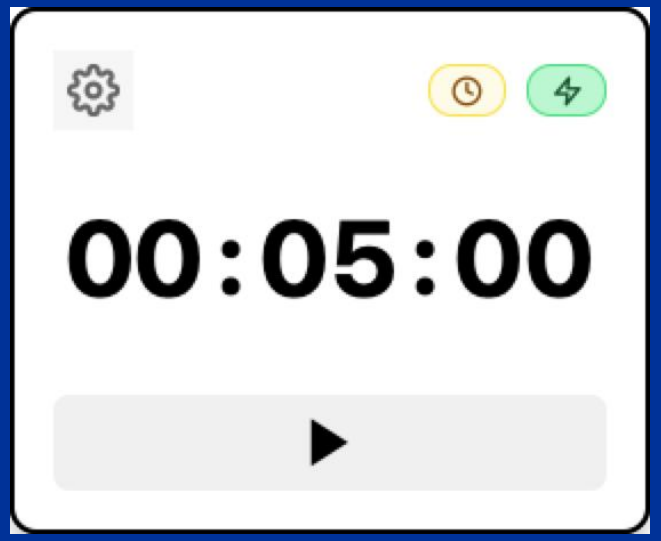
Experience the Practice

See Student Thinking

Unpack the Design

Lesson 1
Pre-Assessment

What do you know about matter?



STC Middle School
Matter and Its Interactions

Investigation 1.1 Describing Matter

Investigation 1.2 The Bottle and the Balloon

Investigation 1.3 The Burning Candle

Investigation 1.4 Comparing Three Mixtures

Investigation 1.5 Reacting a Tablet

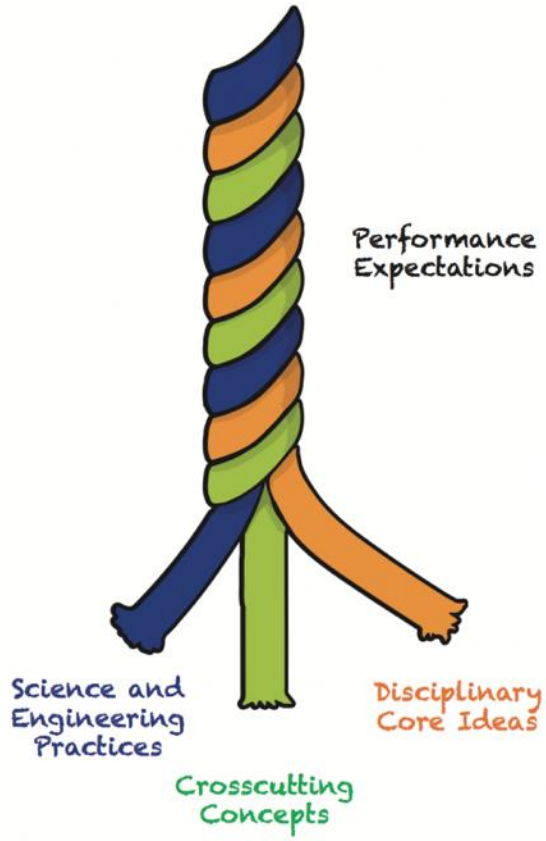
Investigation 1.6 Beads in a Bottle

Investigation 1.7 Floating and Sinking

Investigation 1.8 Filtering a Mixture

CAROLINA
UNLEASH LEARNING

Three-Dimensional Reflection



What practices did you actively engage in?

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

SEPs in Action

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CAROLINA
UNLEASH LEARNING

MELANIE SEEGER

Worthington Hooker School
New Haven Public Schools
Grades 5/6

CLASSROOM DEMOGRAPHICS

50 min. daily instruction

Class size: 22 per section
IEP: 20%
504: 5%
MLL: 9%

SPOTLIGHT STRENGTHS

- Notebooking
- Building routines
- 3 Dimensional teaching

SPOTLIGHT GOAL

The students will have a deeper understanding of the science when doing investigations, specifically understanding analogous relationships, how tools in the investigation are mimicking a real-world phenomenon.

STUDENT GROWTH

Students have grown in their confidence and willingness to take risks and share their thinking.

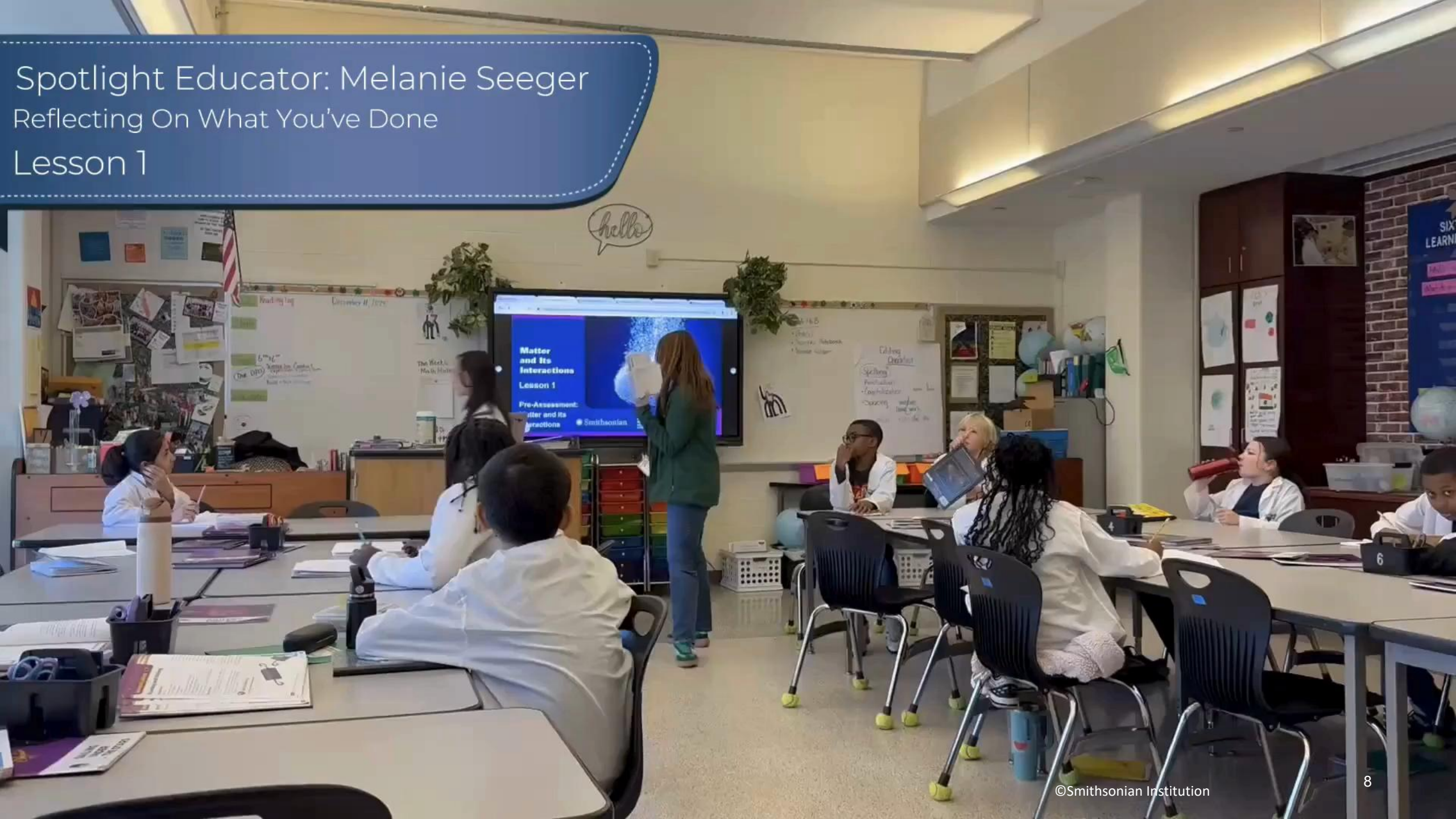
SPOTLIGHT EDUCATOR

"Using the **Smithsonian K-8** curriculum over the past several years has strengthened my teaching and helped my students grow as confident thinkers, collaborators, and problem solvers."

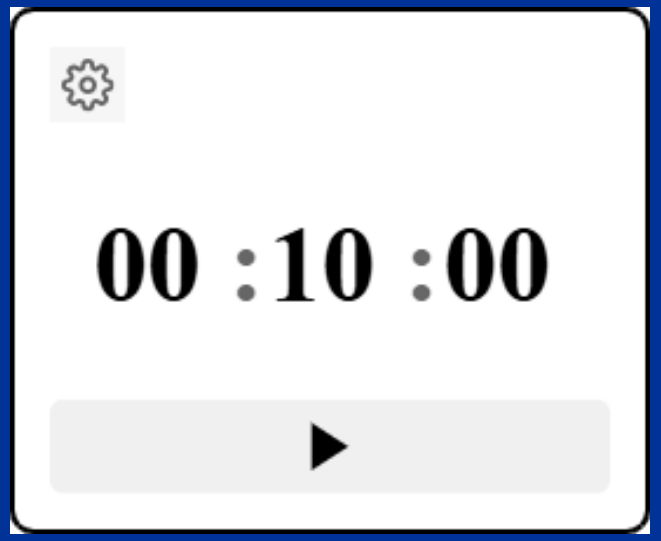
Spotlight Educator: Melanie Seeger

Reflecting On What You've Done

Lesson 1



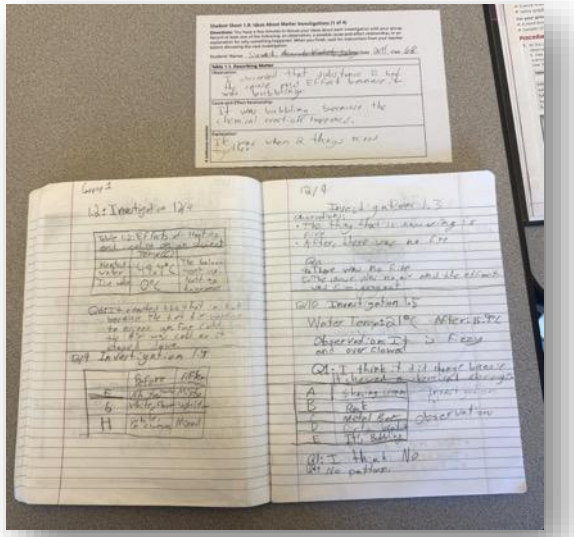
Analyze Authentic Student Thinking



What do you notice?
How is student thinking similar to or different from yours?

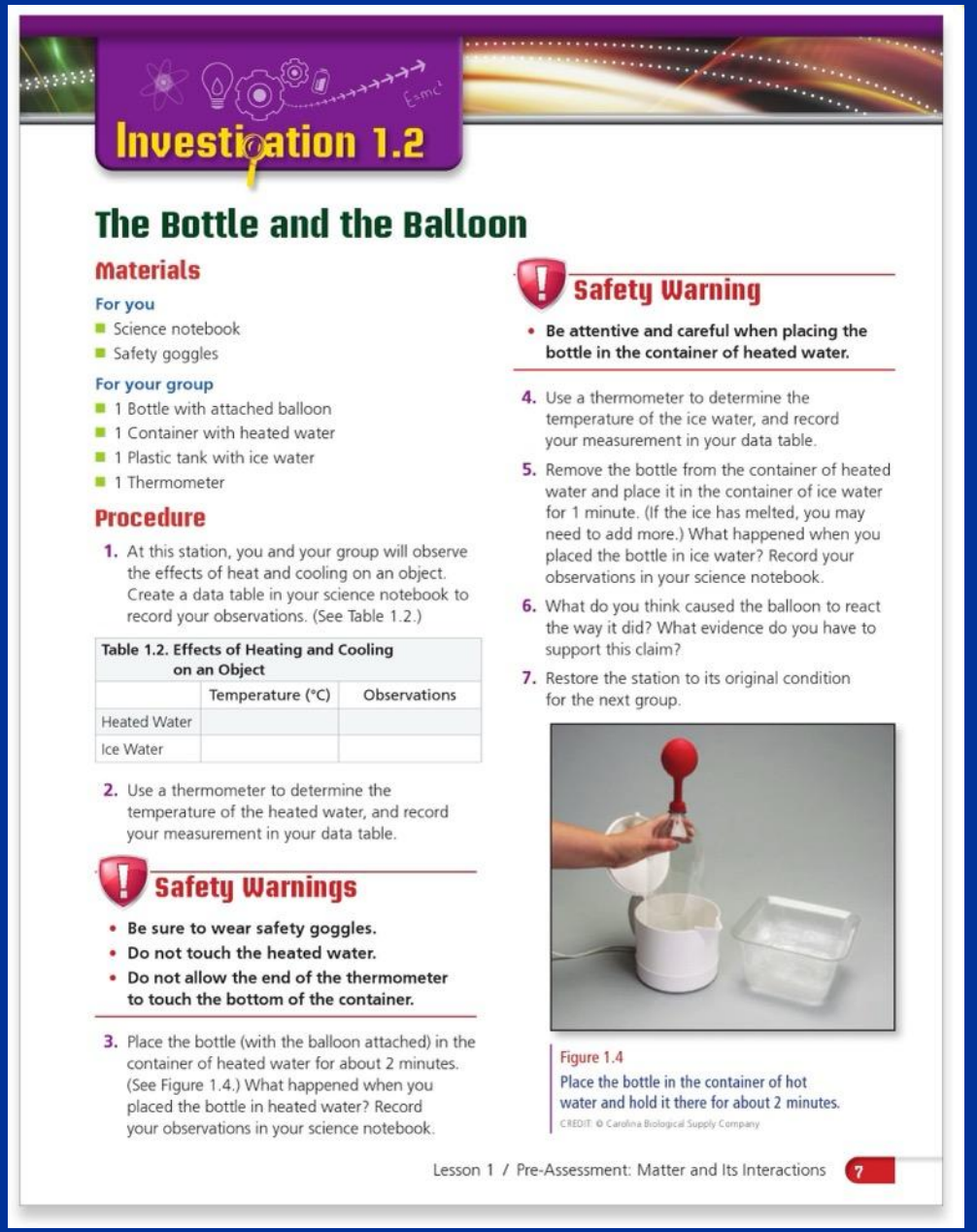
What ideas or misconceptions are visible?
What patterns or partial understandings do you see?

What questions might students still have?
How could instruction build from these ideas?



Investigation 1.2

Matter and Its Interactions
Lesson 1
Investigation 1.2



Investigation 1.2

The Bottle and the Balloon

Materials

For you

- Science notebook
- Safety goggles

For your group

- 1 Bottle with attached balloon
- 1 Container with heated water
- 1 Plastic tank with ice water
- 1 Thermometer

Procedure

1. At this station, you and your group will observe the effects of heat and cooling on an object. Create a data table in your science notebook to record your observations. (See Table 1.2.)

Table 1.2. Effects of Heating and Cooling on an Object

	Temperature (°C)	Observations
Heated Water		
Ice Water		

2. Use a thermometer to determine the temperature of the heated water, and record your measurement in your data table.

Safety Warnings

- **Be sure to wear safety goggles.**
- **Do not touch the heated water.**
- **Do not allow the end of the thermometer to touch the bottom of the container.**

3. Place the bottle (with the balloon attached) in the container of heated water for about 2 minutes. (See Figure 1.4.) What happened when you placed the bottle in heated water? Record your observations in your science notebook.

Safety Warning

- **Be attentive and careful when placing the bottle in the container of heated water.**

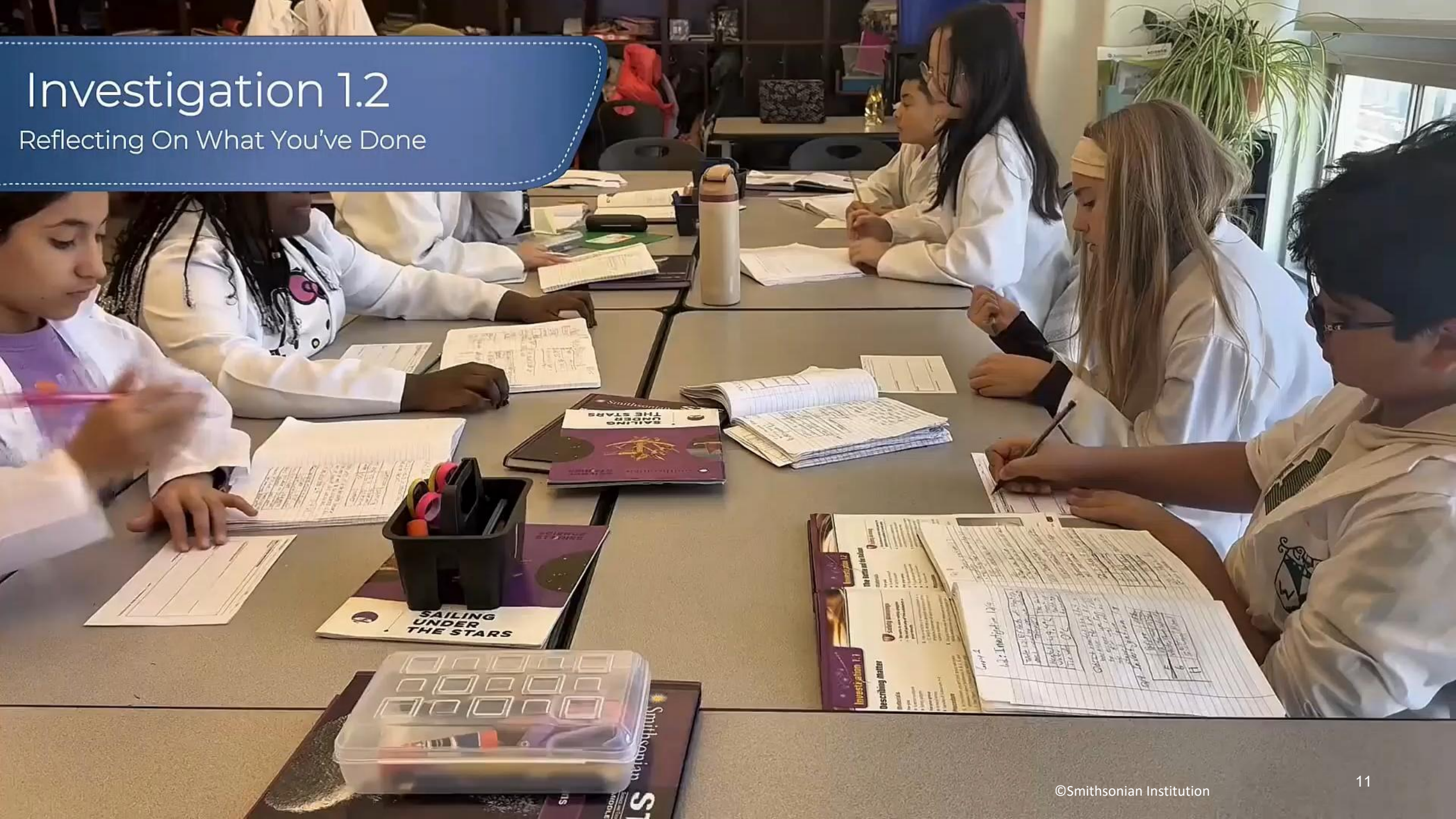
4. Use a thermometer to determine the temperature of the ice water, and record your measurement in your data table.
5. Remove the bottle from the container of heated water and place it in the container of ice water for 1 minute. (If the ice has melted, you may need to add more.) What happened when you placed the bottle in ice water? Record your observations in your science notebook.
6. What do you think caused the balloon to react the way it did? What evidence do you have to support this claim?
7. Restore the station to its original condition for the next group.

Figure 1.4
Place the bottle in the container of hot water and hold it there for about 2 minutes.
CREDIT: © Carolina Biological Supply Company

Lesson 1 / Pre-Assessment: Matter and Its Interactions 7

Investigation 1.2

Reflecting On What You've Done



Investigation 1.5

Matter and Its Interactions
Lesson 1
Investigation 1.5

Investigation 1.5

Reacting a Tablet

Materials

For you

- Science notebook
- Safety goggles

For your group

- 1 Graduated cylinder
- 1 Jar of effervescent tablets
- 1 Test tube
- 1 Test tube brush
- 1 Test tube rack
- 1 Thermometer

Procedure

1. At this station, you and your group will observe what happens to the temperature of water when an effervescent tablet is dissolved in it.

Safety Warnings

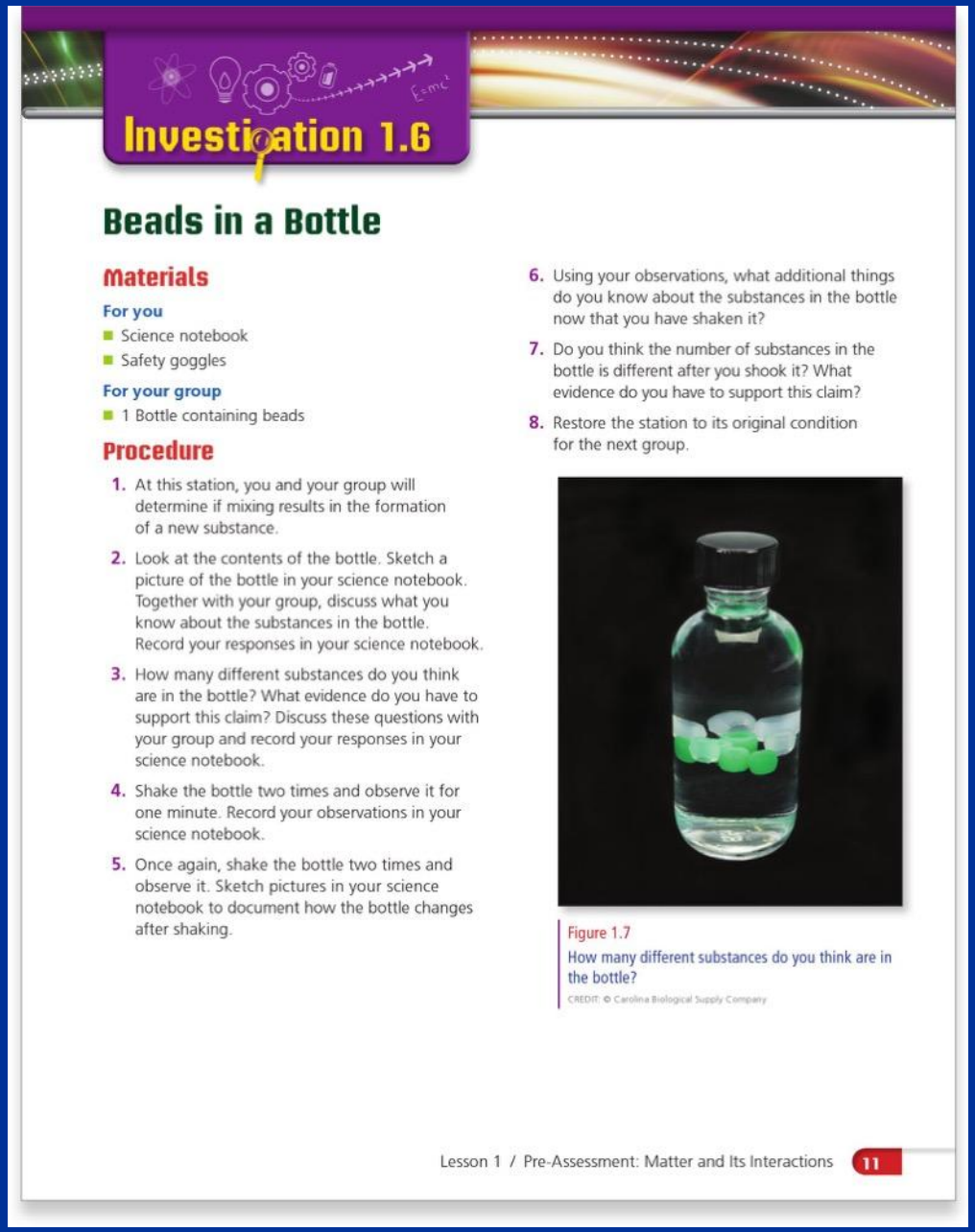
- **Be sure to wear safety goggles.**
- **Do not taste any part of the tablet or the mixture in the test tube.**

2. Add 10 mL of water to the test tube. Put the thermometer in the test tube. (See Figure 1.6.) Wait about 30 seconds and record the temperature in your science notebook.
3. Drop one piece of the effervescent tablet into the water. What happened after the tablet was added to the water? Record your observations in your science notebook.
4. When no further change takes place, record the temperature of the water. How might you account for the temperature change in the water?
5. Do you think a new substance has formed? Justify your answer.
6. Empty out the contents of the test tube and then rinse and dry it.
7. Restore the station to its original condition for the next group.

Figure 1.6
Make sure you wait about 30 seconds after placing the thermometer in the test tube of water before you read the temperature.
CREDIT: © Carolina Biological Supply Company

Investigation 1.6

Matter and Its Interactions
Lesson 1
Investigation 1.6



Investigation 1.6

Beads in a Bottle

Materials

For you

- Science notebook
- Safety goggles

For your group

- 1 Bottle containing beads

Procedure

1. At this station, you and your group will determine if mixing results in the formation of a new substance.
2. Look at the contents of the bottle. Sketch a picture of the bottle in your science notebook. Together with your group, discuss what you know about the substances in the bottle. Record your responses in your science notebook.
3. How many different substances do you think are in the bottle? What evidence do you have to support this claim? Discuss these questions with your group and record your responses in your science notebook.
4. Shake the bottle two times and observe it for one minute. Record your observations in your science notebook.
5. Once again, shake the bottle two times and observe it. Sketch pictures in your science notebook to document how the bottle changes after shaking.
6. Using your observations, what additional things do you know about the substances in the bottle now that you have shaken it?
7. Do you think the number of substances in the bottle is different after you shook it? What evidence do you have to support this claim?
8. Restore the station to its original condition for the next group.

Figure 1.7
How many different substances do you think are in the bottle?
CREDIT: © Carolina Biological Supply Company

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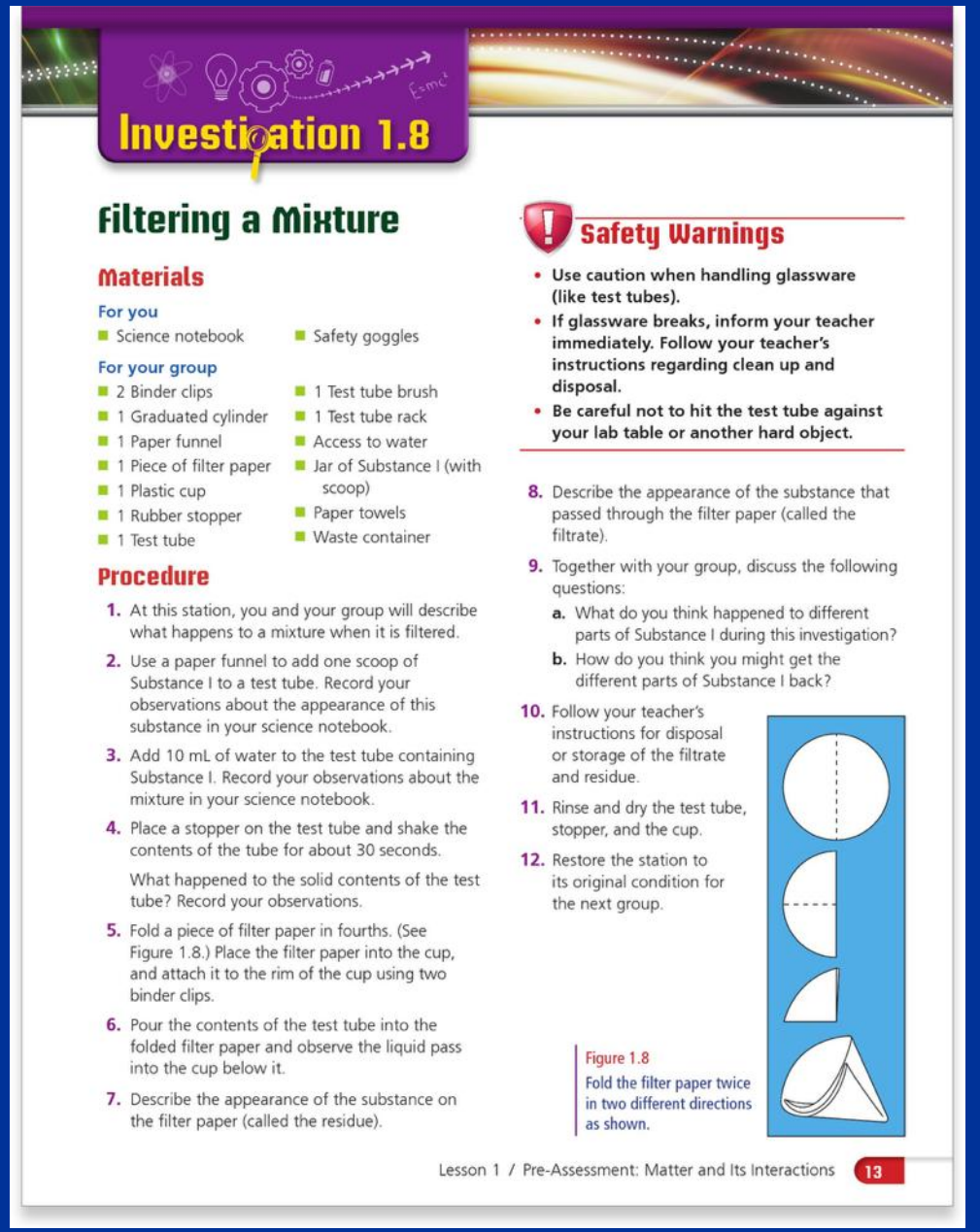
Investigation 1.8

Matter and Its Interactions
Lesson 1
Investigation 1.8



Investigation 1.8

Filtering a Mixture

Materials

For you

- Science notebook
- Safety goggles

For your group

- 2 Binder clips
- 1 Graduated cylinder
- 1 Paper funnel
- 1 Piece of filter paper
- 1 Plastic cup
- 1 Rubber stopper
- 1 Test tube
- 1 Test tube brush
- 1 Test tube rack
- Access to water
- Jar of Substance I (with scoop)
- Paper towels
- Waste container

Procedure

1. At this station, you and your group will describe what happens to a mixture when it is filtered.
2. Use a paper funnel to add one scoop of Substance I to a test tube. Record your observations about the appearance of this substance in your science notebook.
3. Add 10 mL of water to the test tube containing Substance I. Record your observations about the mixture in your science notebook.
4. Place a stopper on the test tube and shake the contents of the tube for about 30 seconds.

   What happened to the solid contents of the test tube? Record your observations.
5. Fold a piece of filter paper in fourths. (See Figure 1.8.) Place the filter paper into the cup, and attach it to the rim of the cup using two binder clips.
6. Pour the contents of the test tube into the folded filter paper and observe the liquid pass into the cup below it.
7. Describe the appearance of the substance on the filter paper (called the residue).

Safety Warnings

- **Use caution when handling glassware (like test tubes).**
- **If glassware breaks, inform your teacher immediately. Follow your teacher's instructions regarding clean up and disposal.**
- **Be careful not to hit the test tube against your lab table or another hard object.**

8. Describe the appearance of the substance that passed through the filter paper (called the filtrate).
9. Together with your group, discuss the following questions:
   a. What do you think happened to different parts of Substance I during this investigation?
   b. How do you think you might get the different parts of Substance I back?
10. Follow your teacher's instructions for disposal or storage of the filtrate and residue.
11. Rinse and dry the test tube, stopper, and the cup.
12. Restore the station to its original condition for the next group.

Figure 1.8
Fold the filter paper twice in two different directions as shown.

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Reflecting On What You've Done

Students' Next Steps: Read *Extending Your Knowledge: Where Did Matter Come From?* Discuss the questions with your group and record responses in your science notebook. **How does this reading influence or revise your ideas about matter?**

Teachers' Next Steps: Read selected student ideas and invite opinions. Focus on inconsistencies that may signal misconceptions, while avoiding evaluation or correction**. Do not provide right or wrong answers.** Encourage students to generate questions that can be investigated later.

EXTENDING YOUR KNOWLEDGE READING SELECTION

Where Did Matter Come From?

Where did all the stuff in the universe—Earth, the Sun, rocks, plants, animals, even you—come from? Was it made at a certain time? If so, how long has it been around? Has it always been there? People have asked these questions since the earliest times.

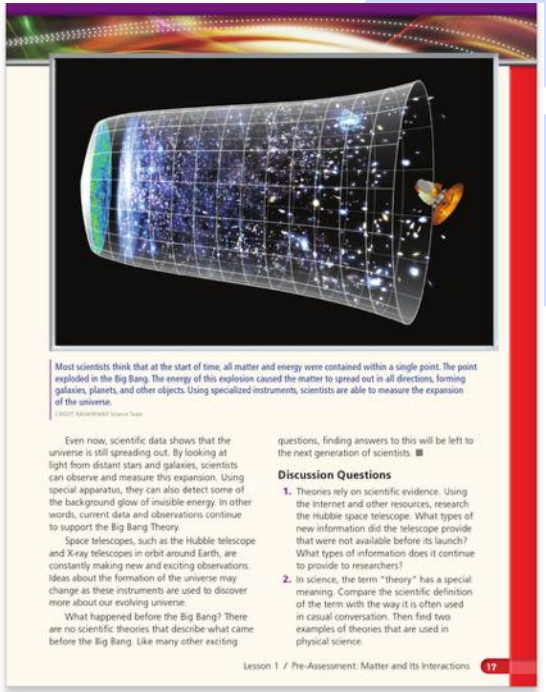
Most cultures have stories of how the universe was created. For instance, the Aboriginal people of Australia tell a story about the Sun, Moon, and stars sleeping beneath the ground. Their ancestors also slept there. One day, the ancestors woke up and came to the surface. The Aboriginal people of Australia call this the Dreamtime. During the Dreamtime, the ancestors walked Earth as animals such as kangaroos, lizards, and wombats. The ancestors made people out of beings that were half animal and half plant. They then went back to sleep. Some went underground, but some became objects such as trees and rocks. The Dreamtime is an important part of Australian Aboriginal culture.

Scientists have also tried to answer the question of how the universe began. When scientists try to answer questions, they sometimes make observations, carry out investigations, and collect data. Scientists use their observations and data to analyze and interpret the phenomena they are studying. After gathering data on many related hypotheses, scientists develop theories. A theory is a unifying explanation for a broad range of hypotheses and observations that have been supported by testing. A theory allows scientists to make predictions about how matter will behave in different situations. If new knowledge does not fit into a theory, the theory is expanded or revised. Scientists have to pose their ideas and leave them open to other scientists to critique. By doing so, a community of scientists ensures that the strongest explanations and ideas can move the field forward.

Over the years, as scientists have gained new knowledge about the universe, new theories have replaced old theories. To gain such knowledge, scientists use models to study systems such as the universe that are too large to observe directly. Many decades of experiments, observations, and scientific argumentation have led to our current theories. Currently, most scientists think the universe started with the Big Bang. The Big Bang theory suggests that all the matter and energy in the universe exploded out from one point. As the explosion occurred, energy and matter spread outward and formed the universe. Matter from the Big Bang formed clouds of gas. As these gases cooled and condensed, stars, galaxies, and eventually planets and other structures that make up the universe were formed.

continued

These Aboriginal people of Australia are painting images of their Dreamtime story.



Most scientists think that at the start of time, all matter and energy were contained within a single point. The point exploded in the Big Bang. The energy of this explosion caused the matter to spread out in all directions, forming galaxies, planets, and other objects. Using specialized instruments, scientists are able to measure the expansion of the universe.

Even now, scientific data shows that the universe is still spreading out. By looking at light from distant stars and galaxies, scientists can observe and measure this expansion. Using special apparatus, they can also detect some of the background glow of invisible energy. In other words, current data and observations continue to support the Big Bang Theory.

Space telescopes, such as the Hubble telescope and X-ray telescopes in orbit around Earth, are constantly making new and exciting observations. Ideas about the formation of the universe may change as these instruments are used to discover more about our evolving universe.

What happened before the Big Bang? There are no scientific theories that describe what came before the Big Bang. Like many other exciting questions, finding answers to this will be left to the next generation of scientists. ■

Discussion Questions

1. Theories rely on scientific evidence. Using the Internet and other resources, research the Hubble space telescope. What types of new information did the telescope provide that were not available before its launch? What types of information does it continue to provide to researchers?
2. In science, the term "theory" has a special meaning. Compare the scientific definition of the term with the way it is often used in casual conversation. Then find two examples of theories that are used in physical science.

SEPs in Action

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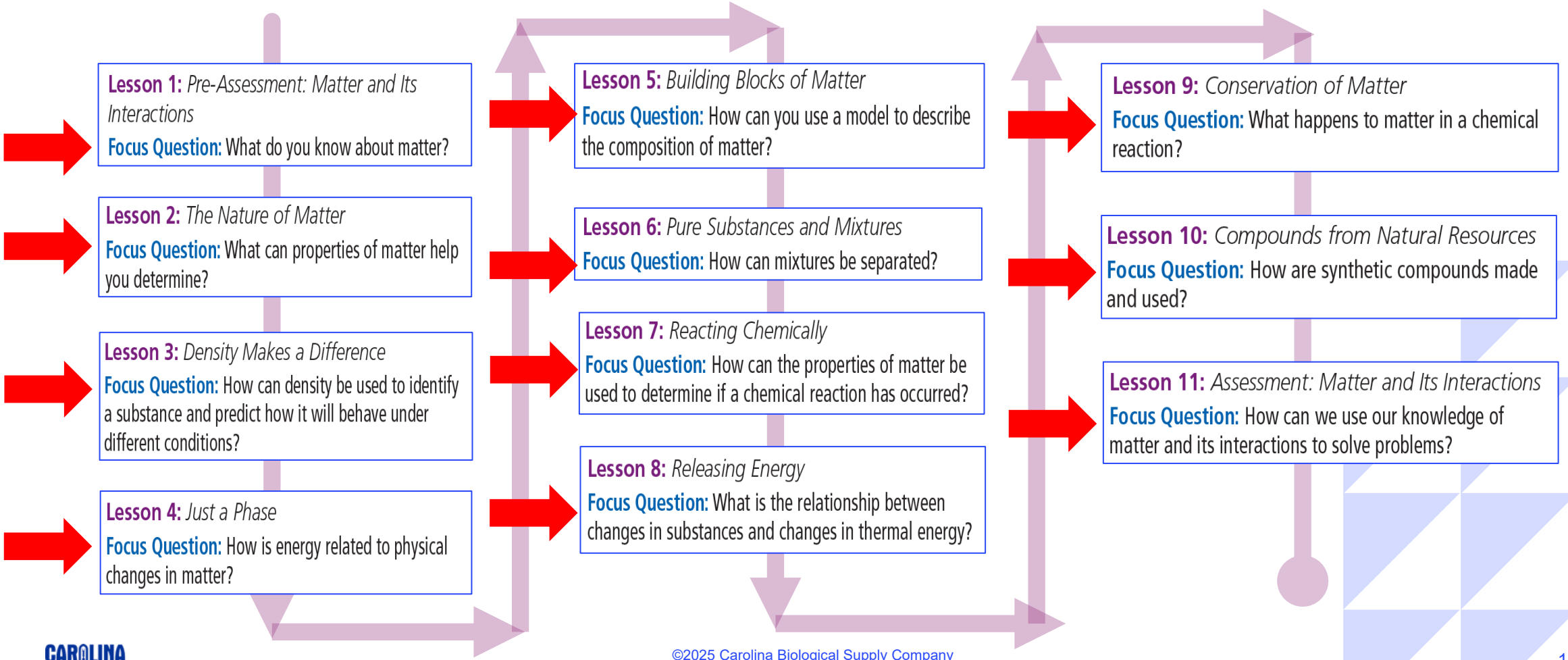
Unpack the Design

Matter & Its Interactions

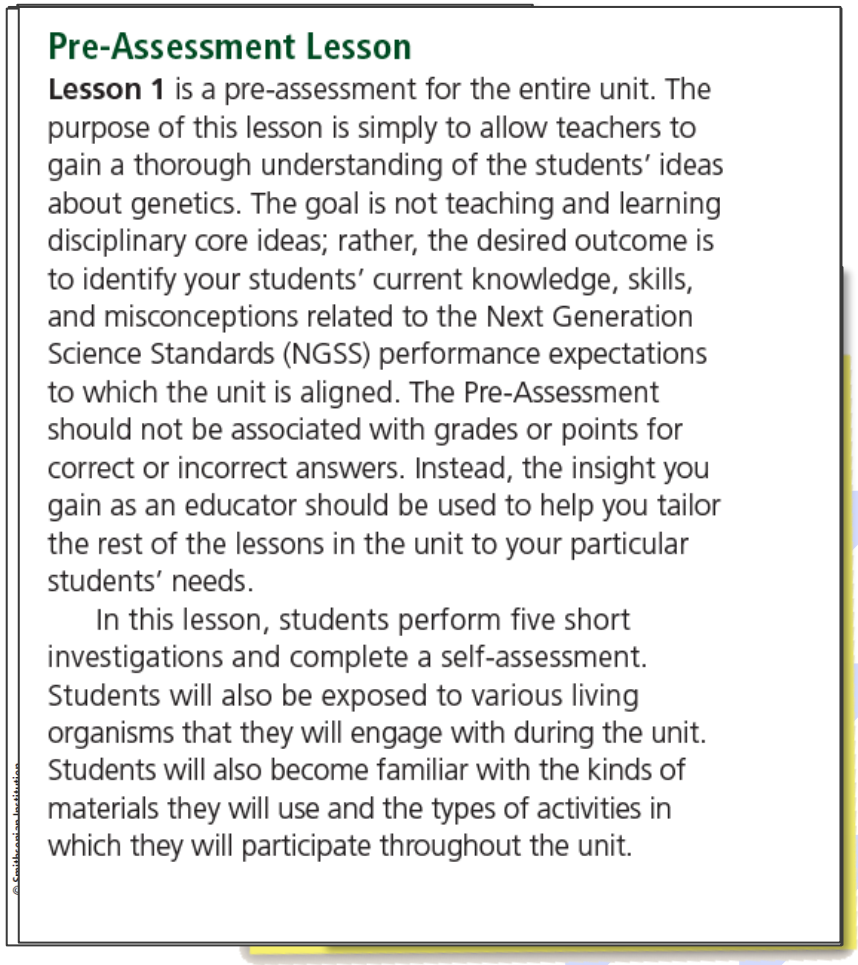
Unit Driving Question: How does matter and its interactions affect everyday life?



3-Dimensional Assessment

Three-dimensional assessment is built into each unit, lesson, and investigation.

- Pre-Assessment
- Formative Assessment
- Summative Assessment
- Rubrics



Pre-Assessment Lesson

Lesson 1 is a pre-assessment for the entire unit. The purpose of this lesson is simply to allow teachers to gain a thorough understanding of the students' ideas about genetics. The goal is not teaching and learning disciplinary core ideas; rather, the desired outcome is to identify your students' current knowledge, skills, and misconceptions related to the Next Generation Science Standards (NGSS) performance expectations to which the unit is aligned. The Pre-Assessment should not be associated with grades or points for correct or incorrect answers. Instead, the insight you gain as an educator should be used to help you tailor the rest of the lessons in the unit to your particular students' needs.

In this lesson, students perform five short investigations and complete a self-assessment. Students will also be exposed to various living organisms that they will engage with during the unit. Students will also become familiar with the kinds of materials they will use and the types of activities in which they will participate throughout the unit.

New Haven District Assessment Results: STCMS Matter & Its Interactions

Disciplinary Core Ideas

	Pre	Mid	Post	Growth
PS1 – Structure and Properties of Matter	31.4%	42.8%	52.6%	**+21.2%**
PS3 – Energy	32.0%	34.6%	NA	**+2.6%**

Science and Engineering Practices

	Pre	Mid	Post	Growth
Analyzing & Interpreting Data	35.3%	41.2%	38.9%	**+3.6%**
Developing & Using Models	34.1%	34.6%	44.7%	**+10.6%**
Engaging in Argument from Evidence	30.2%	NA	66.0%	**+35.8%**
Obtaining, Evaluating, Communicating Information	50.8%	36.9%	42.3%	**-8.5%**

Crosscutting Concepts

	Pre	Mid	Post	Growth
Cause & Effect	32.3%	39.2%	36.5%	**+4.2%**
Energy & Matter	22.6%	NA	46.3%	**+23.7%**
Patterns	35.2%	38.8%	56.7%	**+21.5%**
Scale, Proportion, & Quantity	25.8%	NA	54.7%	**+28.9%**
Structure & Function	47.7%	51.0%	49.7%	**+2.0%**

Teacher Support

Equipment Kits

- Materials for 32 students
  Print, digital, and components

Print and Digital Materials

Compatible with most learning management systems:

Clever (1,320 Schools)

ONEROSTER (250 Schools)

carolina science ONLINE (12,903 Schools)

ClassLink (370 Schools)

Google Classroom (1,628 Schools)

Microsoft

Blackboard

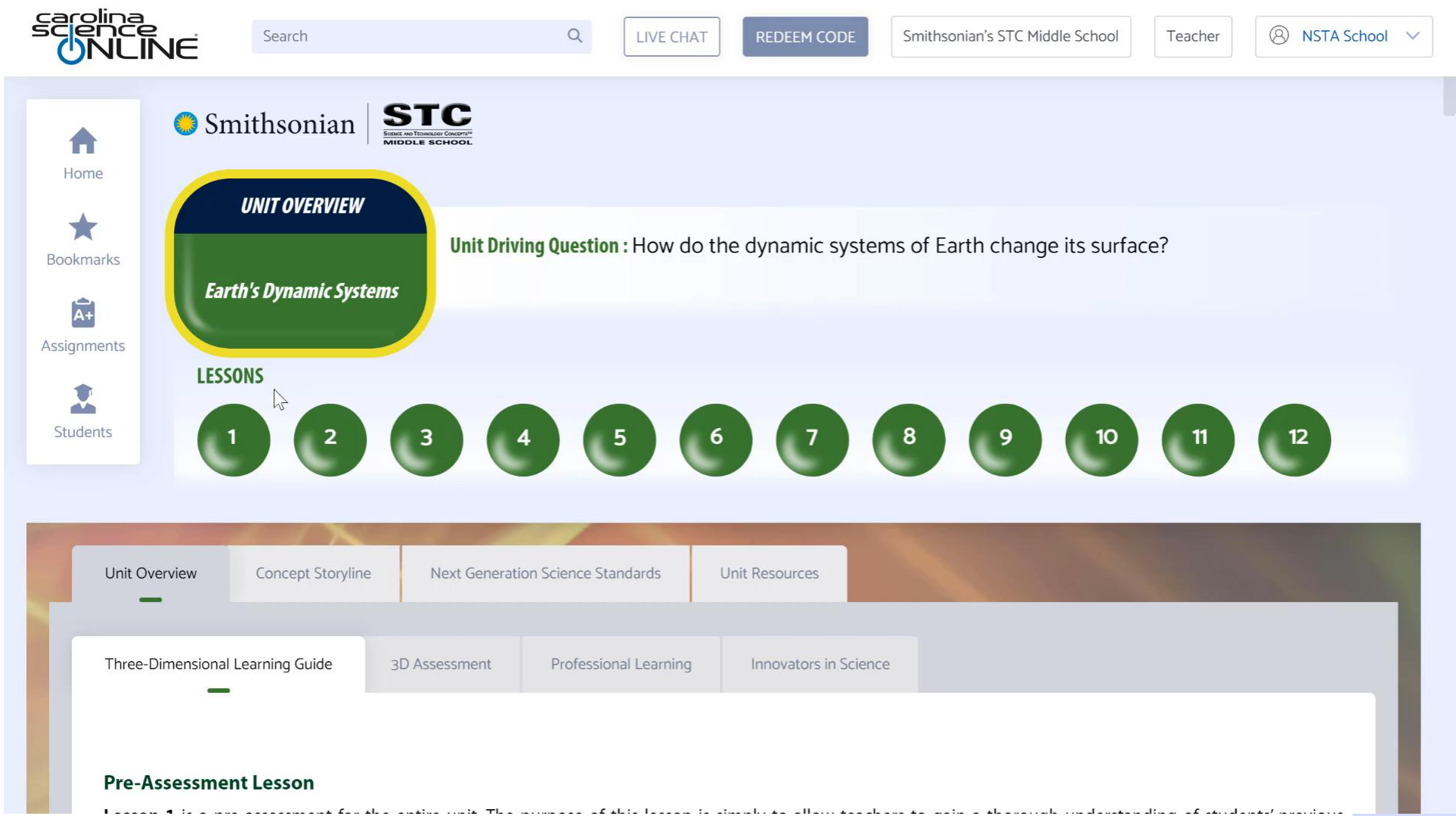
schoology

brightspace

Google Classroom

CANVAS

Print and Digital Materials



Teacher Support

Print and Digital Materials

Student Guides Teacher Editions Slide Presentations

Assessments Videos

Available:

- English
- Spanish

Proven Results

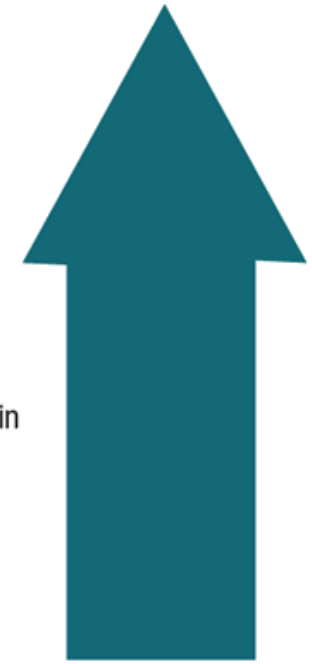
Research-Based and Proven

Inquiry-Based Science Raises Scores in Science, Reading, and Math

5 Year LASER i3 Research Study

The LASER* model of inquiry-based science education resulted in **statistically significant** and **educationally meaningful** improvements in achievement in **science**, **reading**, and **mathematics** as measured by standardized state assessments.

* The Leadership and Assistance for Science Education Reform model developed by the Smithsonian Science Education Center



60,000
Grades 1–8 students impacted

- 43.9% Hispanic
- 30.6% Caucasian
- 19.4% African American
- 2.8% American Indian/ Alaskan Native
- 1.6% Asian

Demographic information represents a subsample of 6,291 students in the study.

Proven Results

Research-Based and Proven

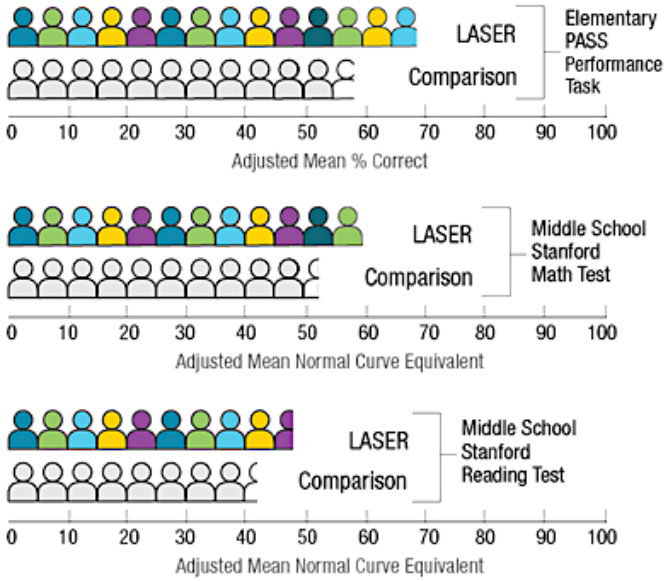
Inquiry-Based Science Raises Scores in Science, Reading, and Math

Inquiry Based

A student-centered method where students ask questions, solve problems, and design solutions and the teacher facilitates learning

Gains in science, reading, and math

Elementary and middle school students in the Houston Independent School District outperformed their peers in science, reading, and math.



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