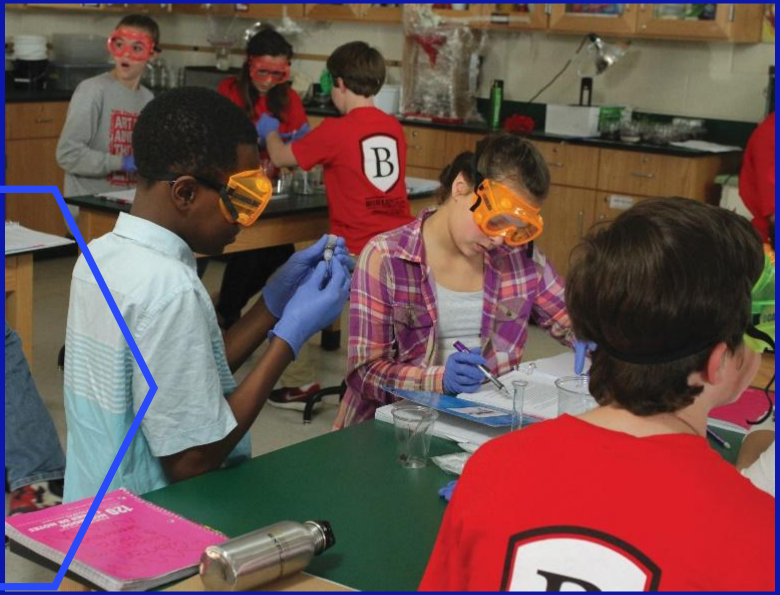
CAROLINA
UNLEASH LEARNING™

CAROLINA® + Smithsonian | STC
SCIENCE AND TECHNOLOGY CONCEPTS™
MIDDLE SCHOOL

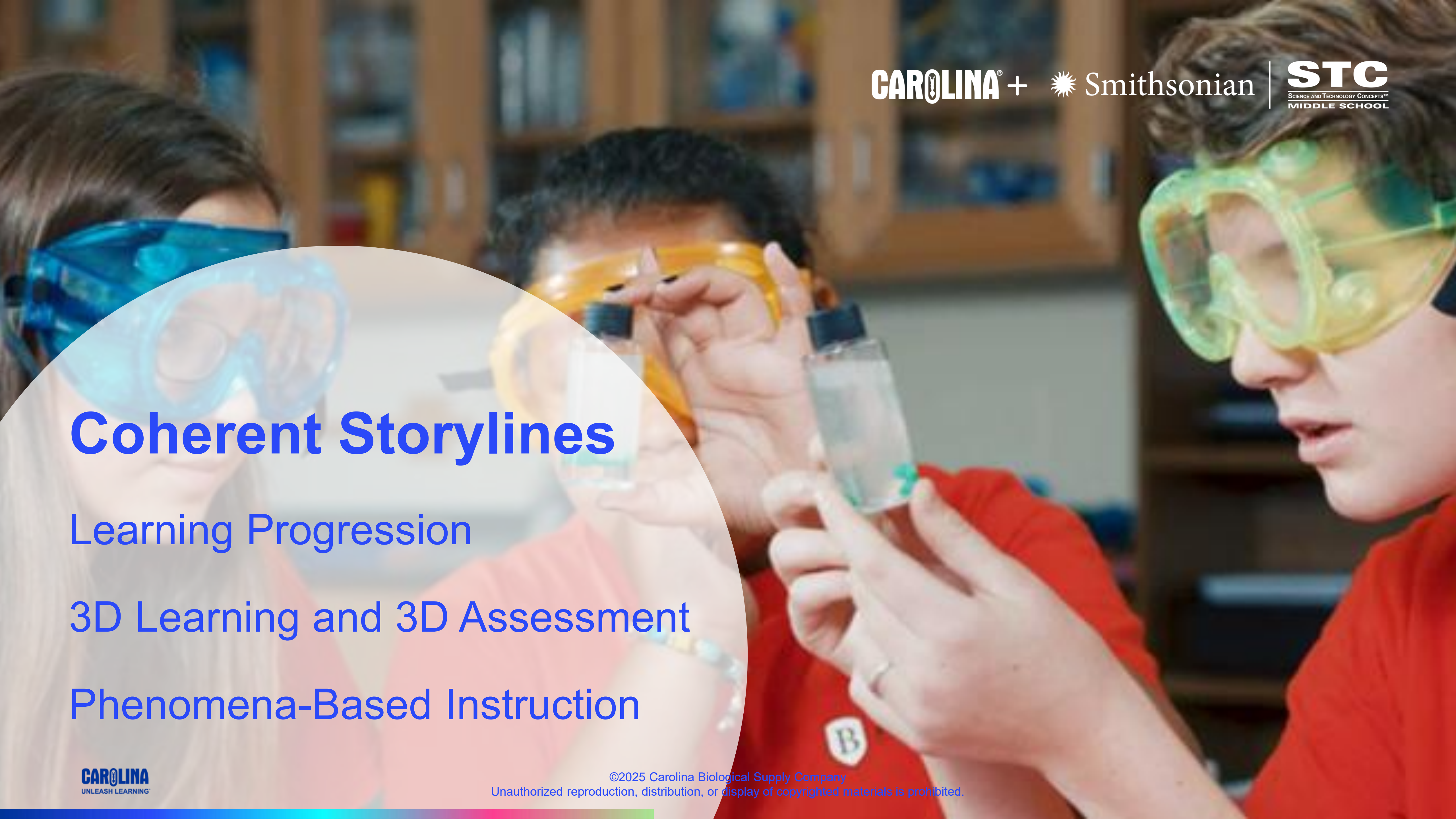
Science You Can Trust. Results You Can See.

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



Setting the Standard

- Coherent Storylines
- Proven Results
- Teacher Support



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

Coherent Storylines

Learning Progression

3D Learning and 3D Assessment

Phenomena-Based Instruction

CAROLINA UNLEASH LEARNING

Matter & Its Interactions

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

Lesson 1: *Pre-Assessment: Matter and Its Interactions*
Focus Question: What do you know about matter?

Lesson 2: *The Nature of Matter*
Focus Question: What can properties of matter help you determine?

Lesson 3: *Density Makes a Difference*
Focus Question: How can density be used to identify a substance and predict how it will behave under different conditions?

Lesson 4: *Just a Phase*
Focus Question: How is energy related to physical changes in matter?

Lesson 5: *Building Blocks of Matter*
Focus Question: How can you use a model to describe the composition of matter?

Lesson 6: *Pure Substances and Mixtures*
Focus Question: How can mixtures be separated?

Lesson 7: *Reacting Chemically*
Focus Question: How can the properties of matter be used to determine if a chemical reaction has occurred?

Lesson 8: *Releasing Energy*
Focus Question: What is the relationship between changes in substances and changes in thermal energy?

Lesson 9: *Conservation of Matter*
Focus Question: What happens to matter in a chemical reaction?

Lesson 10: *Compounds from Natural Resources*
Focus Question: How are synthetic compounds made and used?

Lesson 11: *Assessment: Matter and Its Interactions*
Focus Question: How can we use our knowledge of matter and its interactions to solve problems?

Coherent Storylines

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

Getting Started

1. In the previous lesson, you learned that substances have physical and chemical properties that can be used to identify them. In this lesson, you focus on one physical property: density. You will work in groups to learn how to calculate the density of an object or substance. Also, you will model the organization of particles in substances with different densities and use your model to predict how these substances interact. Remember to follow your teacher's instructions carefully throughout the lesson. Be sure to complete your work neatly and accurately.
2. In your science notebook, write some examples of physical properties from previous lessons. What makes these properties physical properties? Write your responses in your science notebook. Be prepared to contribute your ideas to a class discussion.
3. Read Building Your Knowledge: *Density as a Physical Property*. In your own words, summarize the relationships among mass, volume, and density in your science notebook. Your teacher will lead a class discussion of these relationships.
4. **Models** are tools that scientists use to represent ideas, processes and systems. The diagrams you drew in Lesson 2 are a type of model. Draw a diagram to model the two spoons described in *Density as a Physical Property*. Remember that the spoons are the same size, but one spoon has more mass and higher density. Use simple shapes, such as circles, to represent the particles in your model.
5. Share your density drawing with the class. As a class, discuss the meanings of matter, mass, volume, and density.
6. Look at the object in Figure 3.1. How can density be used to identify what substance this object is made of? Record your response in your science notebook.
7. For some investigations in this lesson, you will use an electronic balance assigned by your teacher. Your group will share the balance with other groups. Before you place anything on the balance, make sure that it reads 0.0 grams (g). If the balance does not read 0.0 g, press the button labeled ZERO. Wait for 0.0 g to appear before continuing. After you have placed an object on the balance, wait a few seconds for the reading to stabilize before recording your measurement.

continued

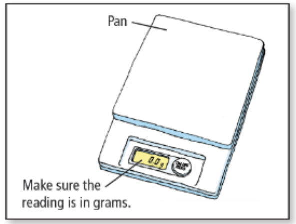


Figure 3.2
Make sure the balance reads 0.0 g before placing an object on it.

Getting Started *continued*

8. During this lesson, you will use graduated cylinders and graduated cups to measure volume. Your teacher will provide your group with these materials so you can look at them. Together with your group, discuss the following questions with your group and be prepared to share your ideas with the class:
   a. Both of these scientific tools are described using the term graduated. What do you think graduated means?
   b. These tools are similar to something you may use to measure at home. What items in your home do these remind you of? What are those items used to measure?
   c. What are the units of measure on the plastic cup? What is the maximum amount it can measure? What is the minimum?
   d. What is the unit of measure for the graduated cylinder? What is the maximum amount it can measure? What is the minimum amount it can measure?
   e. Look at the smallest division on the graduated cylinder. What amount does the smallest division measure?
   f. When would you want to use a disposable measuring device (like a graduated cup) instead of a reusable one (like a graduated cylinder)?
9. Watch the demonstration for the proper procedure for measuring volume using a graduated cylinder. Ask questions about anything that is unclear to you.

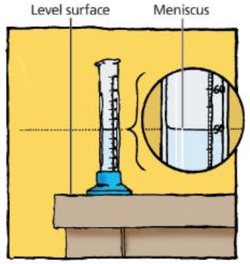


Figure 3.3
Make sure the graduated cylinder is on a level surface. When you take a reading, make sure your eye is level with the bottom of the meniscus. The meniscus is the curved upper surface of the liquid in the cylinder.

BUILDING YOUR KNOWLEDGE *READING SELECTION*

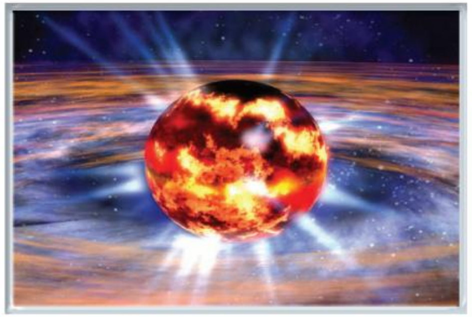
Density as a Physical Property

You've compared the density of objects before, even if you didn't know the meaning of density. Imagine holding two spoons of the same size and shape. One spoon is made of plastic and one spoon is made of metal. The spoons take up the same amount of space, but the metal spoon feels much heavier than the plastic spoon. How is this possible? Even though both spoons are the same size and occupy the same amount of space, the atoms in the metal spoon are more massive and packed more closely together. As more mass is crammed into a given space, the object gets denser.

We can't tell how objects differ in density just by looking at them, but we can tell how they differ by measuring the mass and volume of the objects. A clay brick might be denser than a same-sized brick made of solid foam. But you wouldn't know for sure unless you measured the mass and volume of each brick to calculate its density. So, how do you find an object's density?

Scientists often measure mass in grams (g) and volume in cubic centimeters (cm^3). These units are also used to describe the density. Density is a measure of how much mass is crammed into a certain volume of space. It is measured in grams per cubic centimeter (or other unit of mass per unit of volume). ■

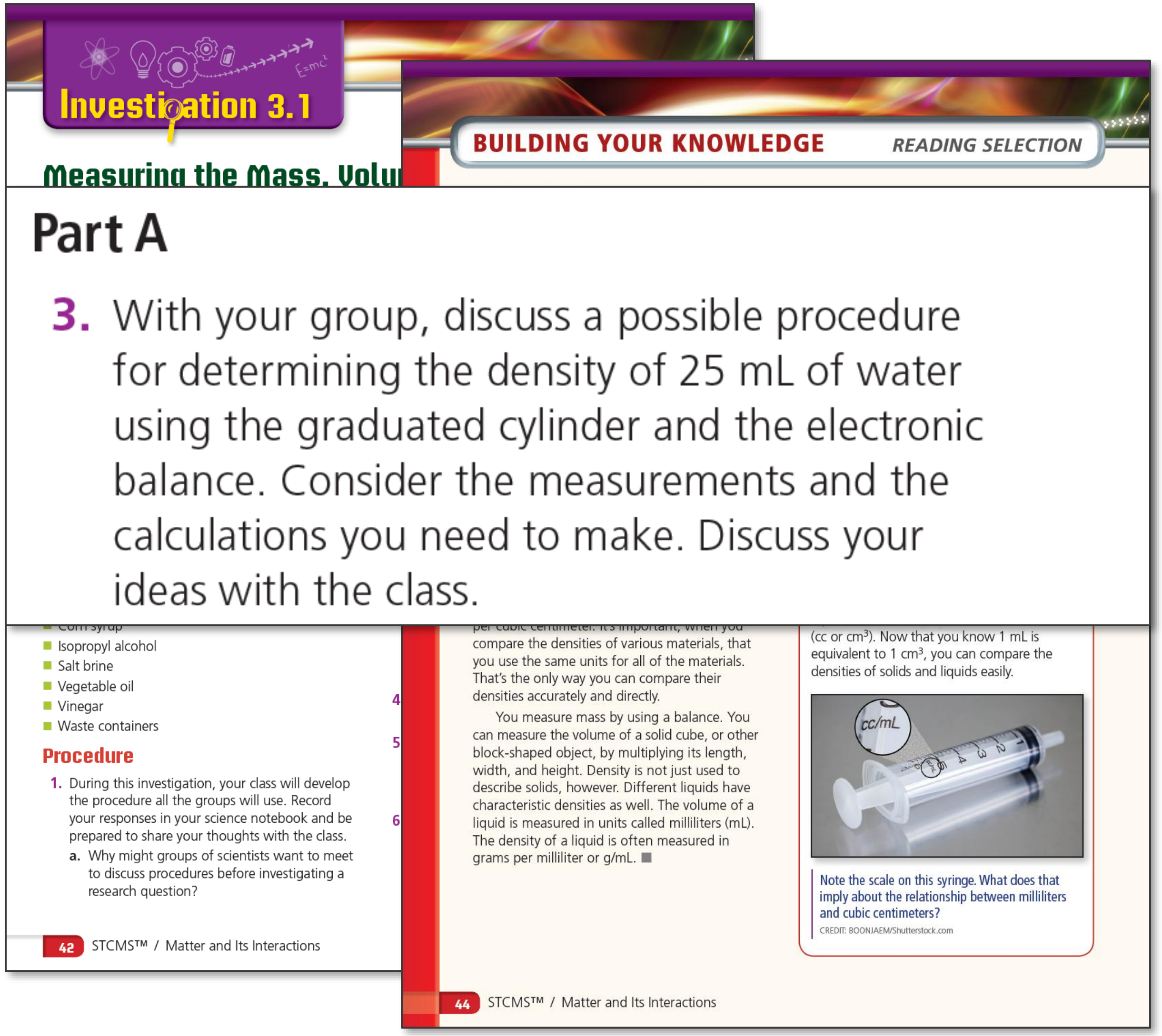
Did you know there's empty space between the atoms of your spoon? Well, there is. You'd be surprised just how much mass can be squeezed together, too. Take neutron stars—the nearly dead, nearly burnt-out remnants of stars much larger than our Sun. A neutron star, according to Dr. Dave Goldberg, co-author of *A User's Guide to the Universe*, can have two or three times our Sun's mass, all of it packed into a ball that could fit inside the borders of Philadelphia. That's pretty dense!



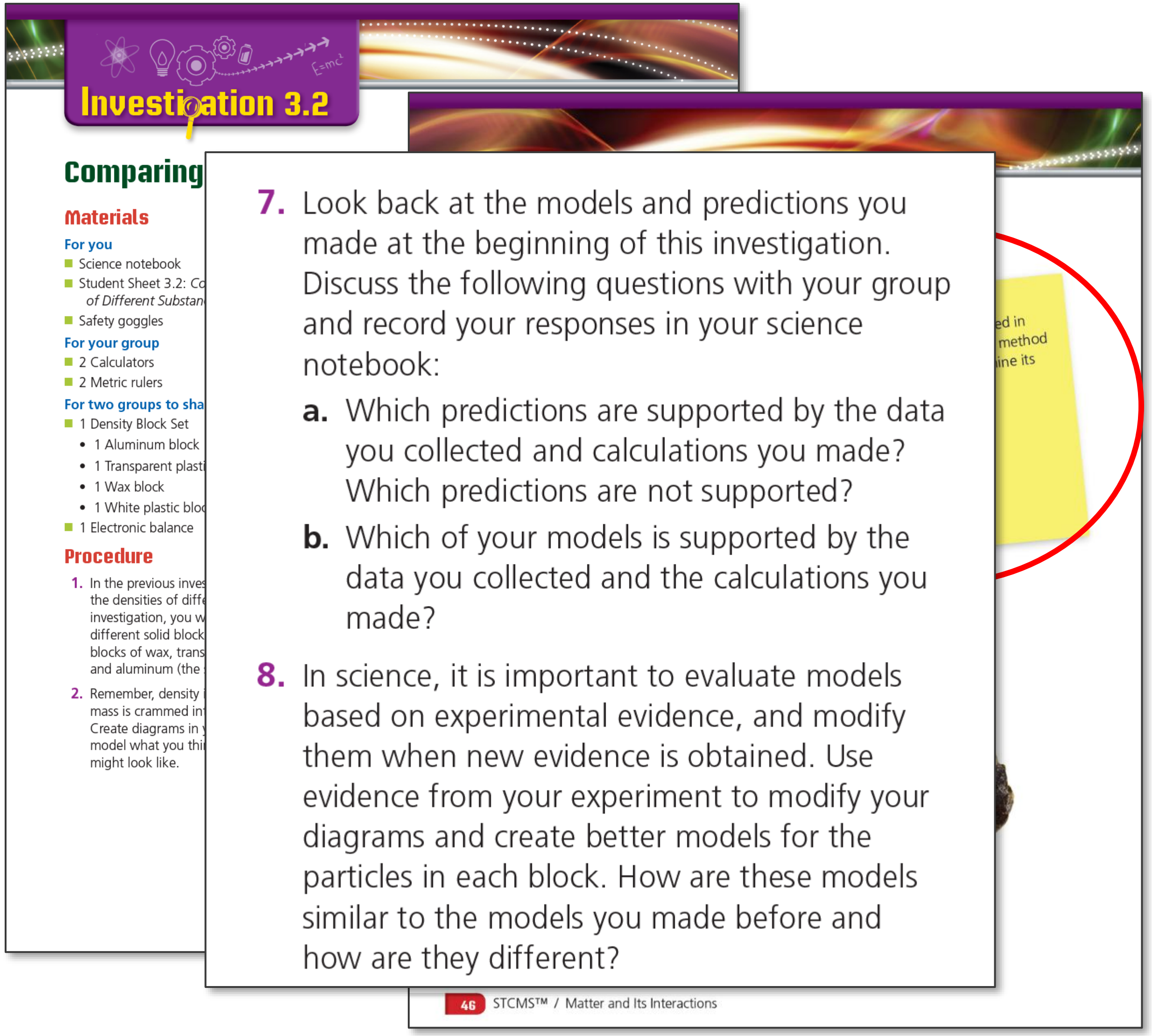
After a star explodes as a supernova, it collapses and the particles are packed together to form a neutron star. A neutron star is so dense that a piece the size of a sugar cube would weigh more than 1 billion metric tons (1.1 billion U.S. tons).
CREDIT: NASA/Dana Berry

CAROLINA UNLEASH LEARNING®

Coherent Storylines



Coherent Storylines



Investigation 3.2

Comparing

Materials

For you

- Science notebook
- Student Sheet 3.2: Co
  of Different Substan
- Safety goggles

For your group

- 2 Calculators
- 2 Metric rulers

For two groups to sha

- 1 Density Block Set
  - 1 Aluminum block
  - 1 Transparent plasti
  - 1 Wax block
  - 1 White plastic bloc
- 1 Electronic balance

Procedure

1. In the previous inves the densities of diff investigation, you w different solid block blocks of wax, trans and aluminum (the
2. Remember, density mass is crammed in Create diagrams in y model what you thi might look like.

ed in
method
ine its

7. Look back at the models and predictions you made at the beginning of this investigation. Discuss the following questions with your group and record your responses in your science notebook:
   a. Which predictions are supported by the data you collected and calculations you made? Which predictions are not supported?
   b. Which of your models is supported by the data you collected and the calculations you made?
8. In science, it is important to evaluate models based on experimental evidence, and modify them when new evidence is obtained. Use evidence from your experiment to modify your diagrams and create better models for the particles in each block. How are these models similar to the models you made before and how are they different?

46 STCMS™ / Matter and Its Interactions

Coherent Storylines

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

Investigation 3.3

Measuring the Densities o

Materials

For you
- Science notebook
- Safety goggles

For your group
- 2 Calculators
- 1 Aluminum cylinder
- 1 Graduated cylinder
- 1 Nylon spacer
- 1 Steel bolt
- Access to water
- Paper towels

For two groups to share
- 1 Electronic balance

Procedure

1. In the previous investigation, you determined the densities of different, regularly shaped solids. In this investigation, you will determine the density of some objects with complex, irregular shapes. Observe the steel bolt, aluminum cylinder, and nylon spacer. Discuss with your group how you could determine the mass and volume of each of these objects. How could you calculate their densities? Be prepared to discuss your group's ideas with the class.
2. As a class, develop a plan that uses the materials provided to determine the density of an irregular object. Once the class has agreed on a plan, record the class procedure in your science notebook.

BUILDING YOUR KNOWLEDGE — *READING SELECTION*

Why Bother with Density?

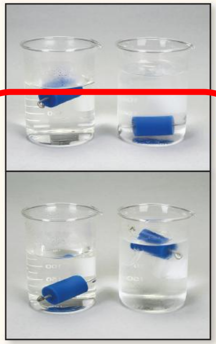
The density of a substance is a characteristic of that substance. Therefore, density is a property that can be used to help identify a substance. Properties that can be used to help identify a substance are called characteristic properties.

Characteristic properties are n affected by the amount or shape of a substance. A drop of water is colorless: so is an entire liter of wa er. A gold earring is as shiny as an ent re bar of gold. Likewise, a spoon ma from silver has the same density as a silver ring. The densities of hundre s of thousands of substances are kn wn and listed in density tables. These values can be used to determine th identity of an unknown substance. But, of course, you have to be able to measure the mass and volume o the substance.

Density tables frequently includ the temperature at which the dens y of a substance has been measured. The densities of substances should only e compared at the same temperature. Why? The volume of many substances increases as temperature increases and it decreases as temperature decreases.

Consider the cylinders used during Investigation 1.7: Floating and Sinking. The cylinders are identical, but they behaved differently because the temperature of the water was different. When the cylinders were heated, the particles in them moved apart and the density decreased. This happens because the mass of the cylinder stayed the same, but the volume increased. The increase in the volume of matter with increasing temperature is called **expansion**. The opposite process, **contraction**, is a decrease in the volume of matter with decreasing temperature. When the cylinders were cooled, the particles in them moved closer together, and the density increased. This happened because the mass of the cylinder stayed the same and the volume decreased.

A few substances behave differently when heated or cooled. Water is one such substance. When water approaches freezing, it expands and becomes less dense, which is why water pipes sometimes burst when they freeze and why icebergs float. ■



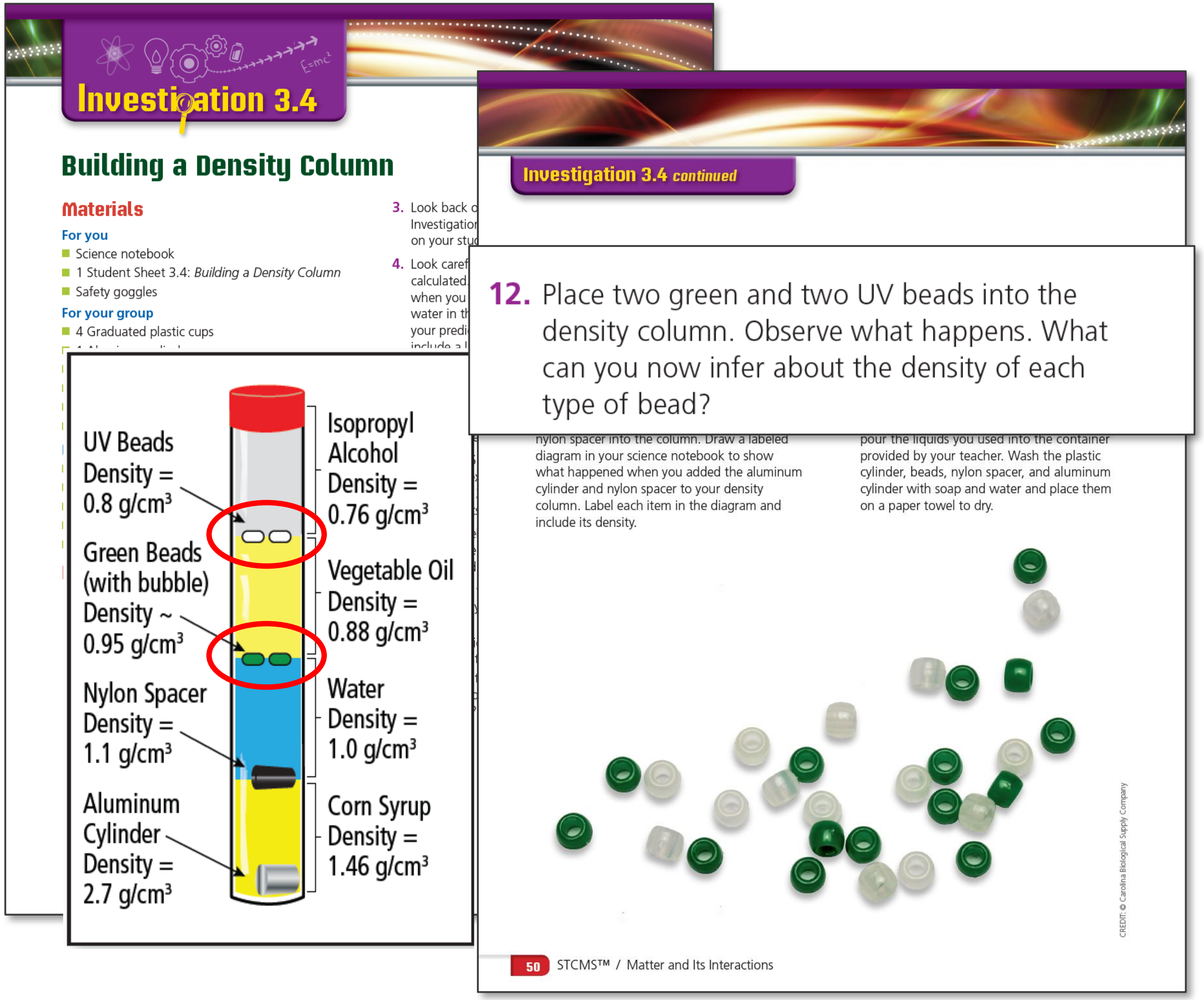
◀ If ice water (4°C [39°F]) has a density of 1.0 g/cm^3 and hot water (80°C [176°F]) has a density of 0.99 g/cm^3, what can you infer about the ensity of the cylinders?

CRE T: © Carolina Biological Supply Com any

▶ This Galileo thermometer utilizes liqui -filled bulbs. As a liquid's temperature increases it expands and the density decreases. The t g on the lowest floating bulb indicates the temper ture.

CREDIT: © Carolina Biological Supply Company

Coherent Storylines



Investigation 3.4

Building a Density Column

Materials

For you

- Science notebook
- 1 Student Sheet 3.4: *Building a Density Column*
- Safety goggles

For your group

- 4 Graduated plastic cups

Investigation 3.4 *continued*

12. Place two green and two UV beads into the density column. Observe what happens. What can you now infer about the density of each type of bead?

nylon spacer into the column. Draw a labeled diagram in your science notebook to show what happened when you added the aluminum cylinder and nylon spacer to your density column. Label each item in the diagram and include its density.

pour the liquids you used into the container provided by your teacher. Wash the plastic cylinder, beads, nylon spacer, and aluminum cylinder with soap and water and place them on a paper towel to dry.

CREDIT: © Carolina Biological Supply Company

50 STCMS™ / Matter and Its Interactions

Coherent Storylines

Investigation 3.5

Building a Density Bottle

Materials

For your teacher
- Bottle containing beads

For you
- Science notebook
- 1 Student Sheet 3.5: *Building a Density Bottle*
- Safety goggles

For your group
- 6 Graduated plastic cups
- 1 Jar of beads
- 1 Plastic bottle
- Access to water
- Paper towels

For two groups to share
- 1 Electronic balance

For the class
- Containers for used liquids
- Corn syrup
- Isopropyl alcohol
- Salt brine
- Vegetable oil
- Vinegar
- Access to water

Procedure

1. In the previous investigation, you made predictions about the appearance of different substances when they are combined. In this investigation, you apply what you have learned about density to design a density bottle similar to the one you used in the pre-assessment activity. (See Figure 3.5.) Look back at your observations from Investigation 1.6: Beads in a Bottle. How has your understanding of the substances in this bottle changed since then? Discuss your answer with the class.
2. Look back on the data you collected in Investigation 1.6: Beads in a Bottle. What does the data you collected tell you about the density of each type of bead?
3. Look back on the data you collected during Investigation 3.1, and use it to fill in Table 1 on Student Sheet 3.5: *Building a Density Bottle*. Your teacher used two of the liquids from Investigation 3.1 to create the bottle you used in the pre-assessment. Do you have enough information to determine what liquids your teacher used? Why or why not?
4. Use the graduated cups to obtain 30-mL samples of each liquid you think your teacher may have used. Place one green and one UV bead in each cup and record your observations in Table 1. (Check to ensure that no beads have air bubbles attached to them.)

continued

Figure 3.5
What liquids do you think your teacher used to create this bottle?
CREDIT: © Carolina Biological Supply Company

3-Dimensional Assessment

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.

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

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

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

Coherent Storylines

Learning Progression

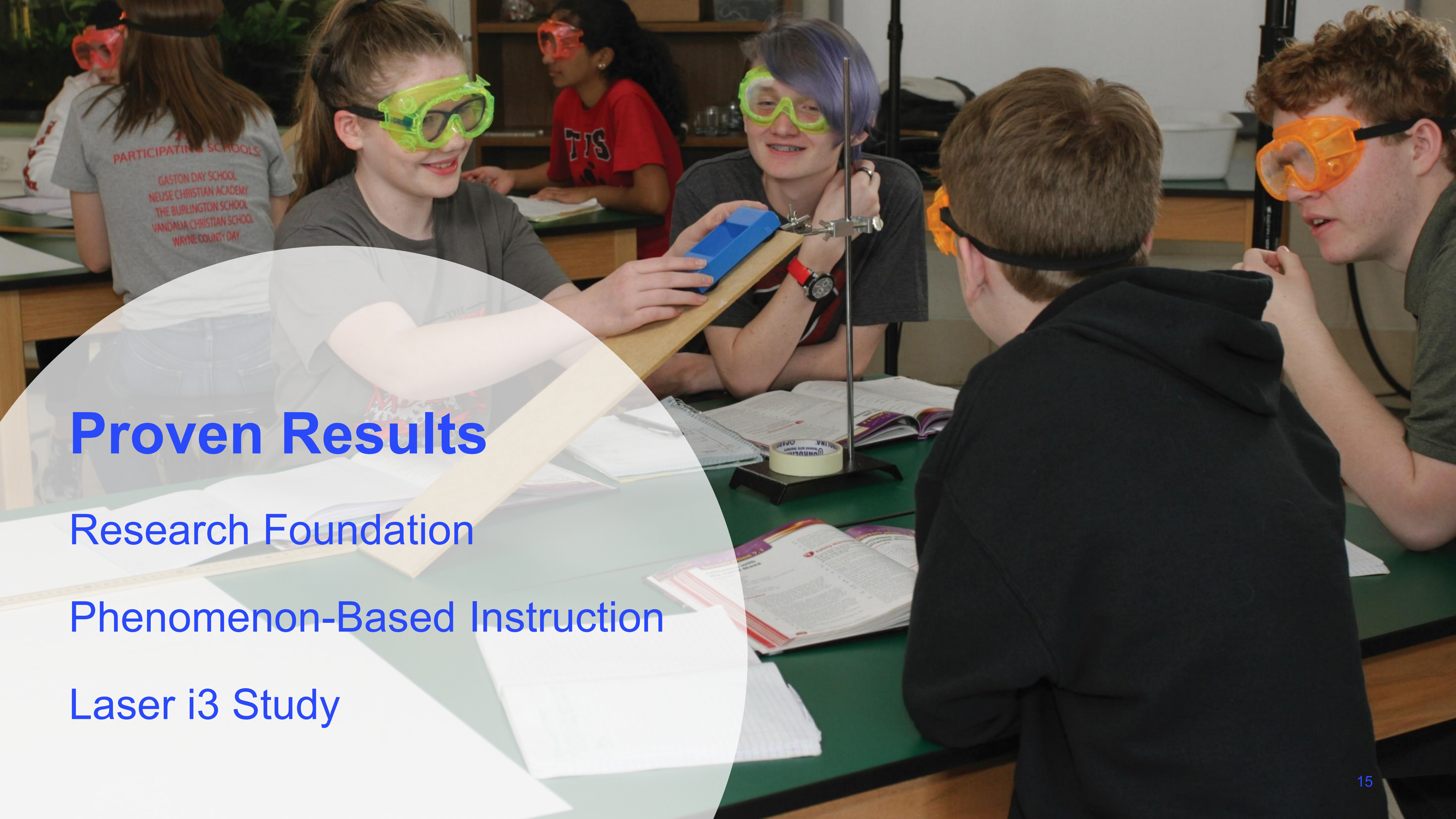
3D Learning and 3D Assessment

Phenomena-Based Instruction

CAROLINA UNLEASH LEARNING™

Setting the Standard

- Coherent Storylines
- Proven Results
- Teacher Support



Proven Results

Research Foundation

Phenomenon-Based Instruction

Laser i3 Study

Proven Results

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

eMaMMAL

NASA

United States Environmental Protection Agency

Smithsonian
Science Education Center

National Oceanic and Atmospheric Administration
NOAA
U.S. Department of Commerce

CAROLINA
K-8 CURRICULUM

USDA
United States
Department of Agriculture

Proven Results

Research-Based and Proven

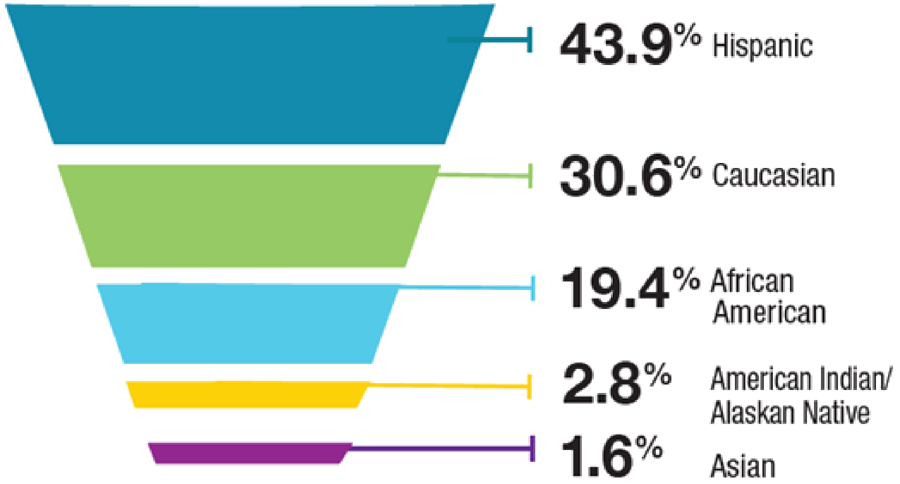
Inquiry-Based Science
Raises Scores in Science, Reading, and Math

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



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

Proven Results

Research-Based and Proven

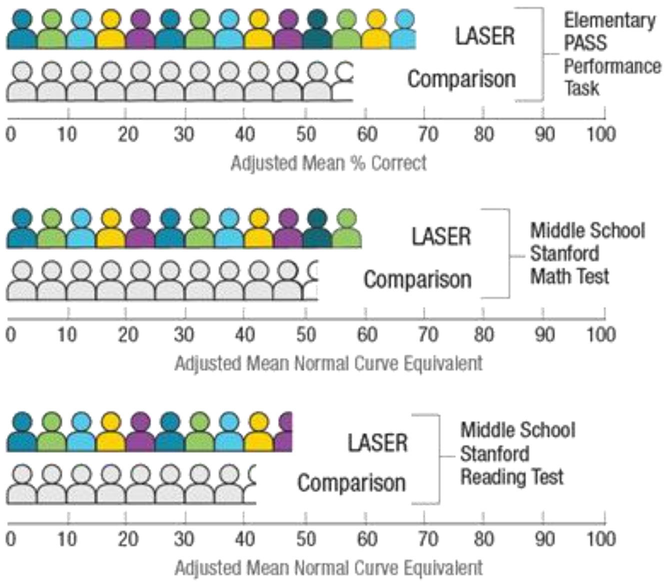
Inquiry-Based Science
Raises Scores in Science, Reading, and Math

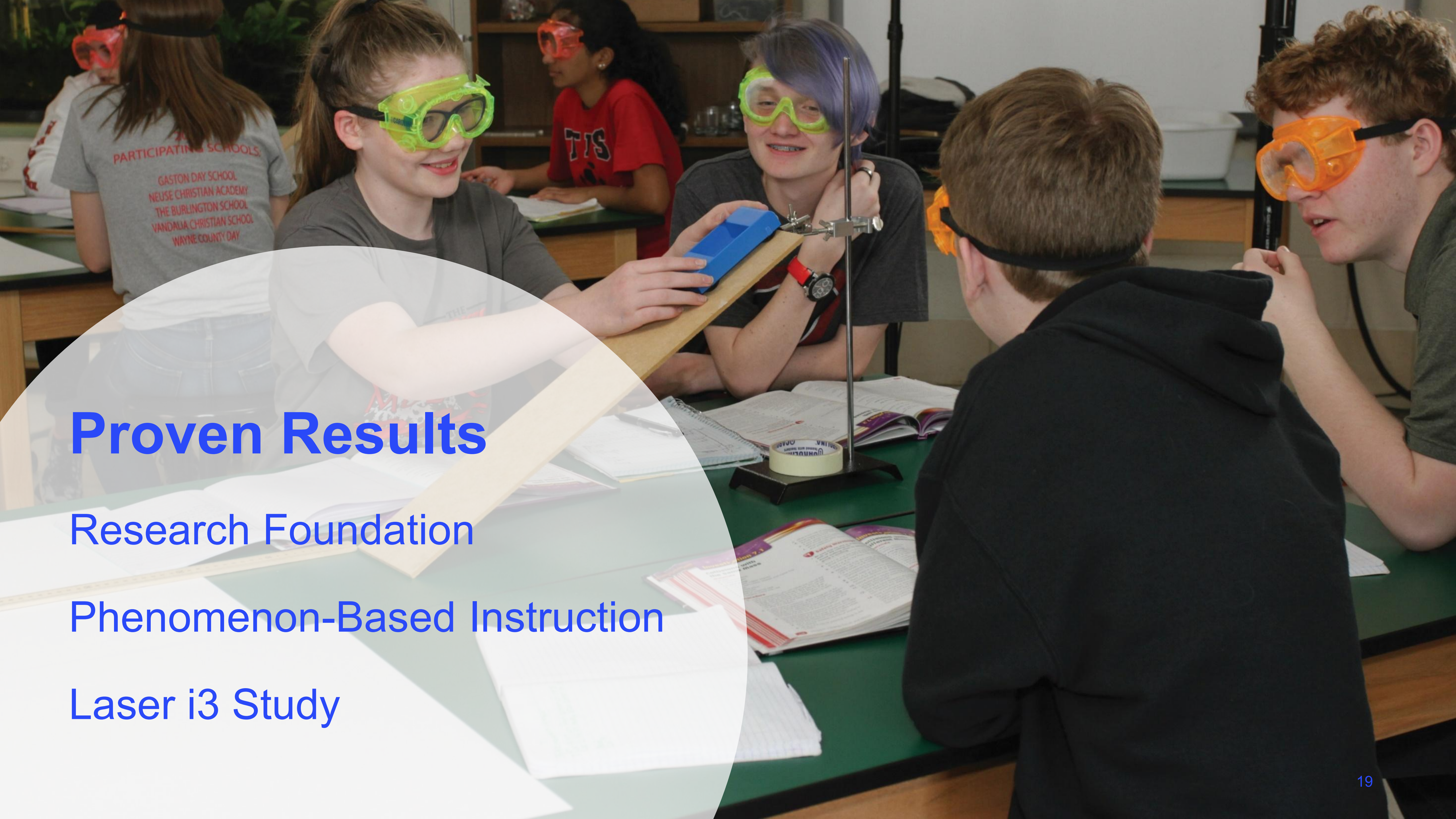
Inquiry Based

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.





Proven Results

Research Foundation

Phenomenon-Based Instruction

Laser i3 Study

Setting the Standard

- Coherent Storylines
- Proven Results
- Teacher Support

Teacher Support

Easy-to-Use Teacher Edition

New Easy-to-Use Digital Resources

Phenomena-Based Instruction

Teacher Support

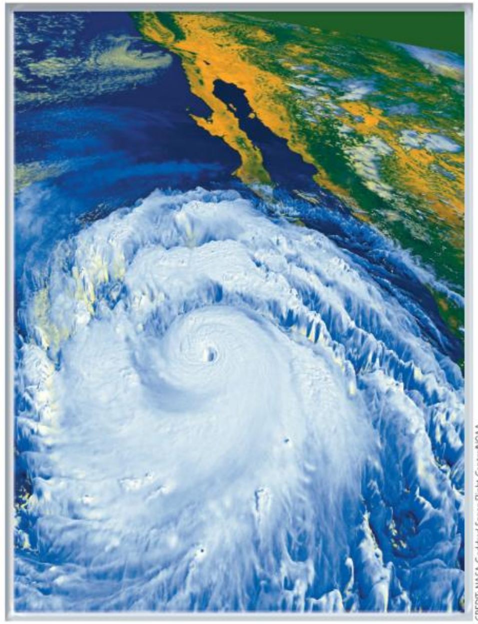
CAROLINA + Smithsonian | STC SCIENCE AND TECHNOLOGY CONCEPTS™ MIDDLE SCHOOL

Unit Overview

In **Lesson 5**, students explore the conditions under which the ocean gains and loses heat energy and develops two kinds of (ultimately) heat-driven currents: surface currents and deep currents. Students are introduced to the ocean as a reservoir and transporter of heat. They also study ways in which ocean currents move heat around the globe.

The lesson begins as students investigate how Earth's shape and orientation to the Sun result in uneven heating of its surfaces. Then, over the course of three investigations, students explore the effects of water's fluctuating density and the wind on ocean currents. In Investigation 5.1, they determine how temperature affects currents. Then they discover the role that salinity plays in driving the ocean's movements in Investigation 5.2. Finally, students explore surface currents in Investigation 5.3 to see how wind impacts ocean currents.

In **Lesson 6**, students learn what conditions are necessary for the formation of storms, particularly the vortices known as hurricanes and tornadoes. Students begin by studying satellite images and drawing the parts of a hurricane. During Investigation 6.1, students use a model made with two connected bottles filled with water and glitter to simulate and observe a vortex. They apply their observations of the model to the movement of air in a tornado or hurricane and develop a definition of the word "vortex." By the end of Lesson 6, students will demonstrate an understanding of how vortices form and behave.



CREDIT: NASA Goddard Space Flight Center/NOAA

In **Lesson 7**, students begin their work with weather maps and weather predictions. During Investigation 7.1, students begin a five-day project that includes collecting daily weather data, observing clouds, looking for patterns and relationships in the data, and attempting to predict the weather by using any relationships observed in the data. Some of the data collection will need to be done as homework. In Investigation 7.2, students apply their observations to weather maps and draw conclusions about the conditions under which clouds and storms form and move. In Investigation 7.3—conducted after students have had ample time to collect weather data—students analyze and graph their weather data and note any patterns they can find. Then, students share the results of their weather data project with the class and construct scientific explanations about using current weather data to make predictions.

In **Lesson 8**, students explore the impacts of severe storms and how the storms are predicted. Students investigate hurricane

In **Lesson 10**, students explore the data scientists collect related to climate change. Students have been exposed to the uncertainty scientists face in collecting and interpreting data, and they are beginning to develop a sense of what it means to make tentative statements of fact based on data that is imperfect and fragmentary but intelligently collected and analyzed.

Students explore these concepts by measuring the temperature in an area and then finding a way to represent the data with a single value. Next, students are presented with and discuss how and why different types of data are collected as evidence of climate change. Each group is assigned or selects a graph of climate data to analyze and interpret. Students engage in research aimed at a deeper, more contextualized understanding of what the graph means, how its data has been collected, and why the subject under study is important. Then, in Investigation 10.2, students present their research to the class, allowing the whole class to get familiar with different pieces of climate change research.

In **Lesson 11**, students analyze the impact of climate change, explore how scientists project trends to predict the future, and explore how scientists simulate future conditions and monitor effects. Students recall what they have learned in previous lessons about climate change and consider how scientists make climate predictions. In Investigation 11.1, students look forward 100 years using the United States Global Change Research Program (USGCRP) report, *Global Climate Change Impacts in the United States* (2014), and explore temperature and precipitation projections for their area. These projections do not have the certainty of predictions, but they will give students a sense of what climatologists expect for their region. The projections also introduce practical issues of climate change that regional planners, health officials, farmers, engineers, and others must consider. In Investigation 11.2, students learn how researchers at the Smithsonian Environmental Research Center simulate higher CO_2 and nitrogen levels and sea level rise expected in the future to monitor their effects on wetlands.

Assessment Lesson

In Lesson 12, you will access the skills and knowledge students have acquired throughout the unit. No teaching or learning of new content is intended; the assessment should be used to measure how far students have come and to diagnose any remaining knowledge gaps or misconceptions. This assessment has two parts: the Performance Assessment and the Written Assessment. In the **Performance Assessment**, students apply the knowledge and skills they have acquired during the unit to analyze data in order to predict future weather conditions. In the **Written Assessment**, students respond to multiple-choice and constructed-response items aligned to concepts covered in this unit.

CREDIT: Florida Stock/Shutterstock.com

Teacher Support

Equipment Kits

- **Materials for 32 students**
  Print, digital, and components

Print and Digital Materials

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

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

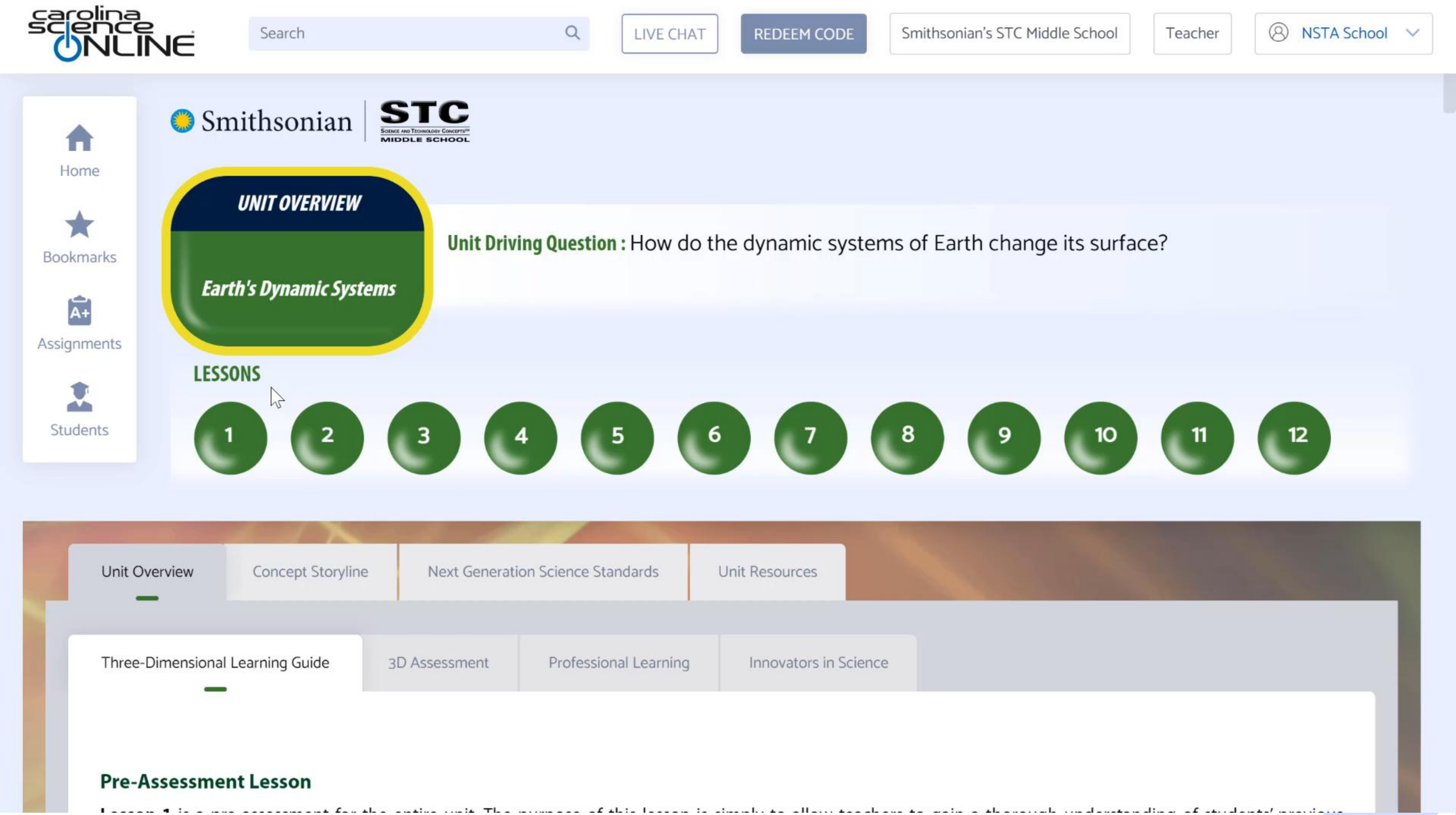
Schoology

Brightspace

Google Classroom

Canvas

Print and Digital Materials



Teacher Support

Print and Digital Materials

Student Sheets
Simulations & Animations
Teacher Edition

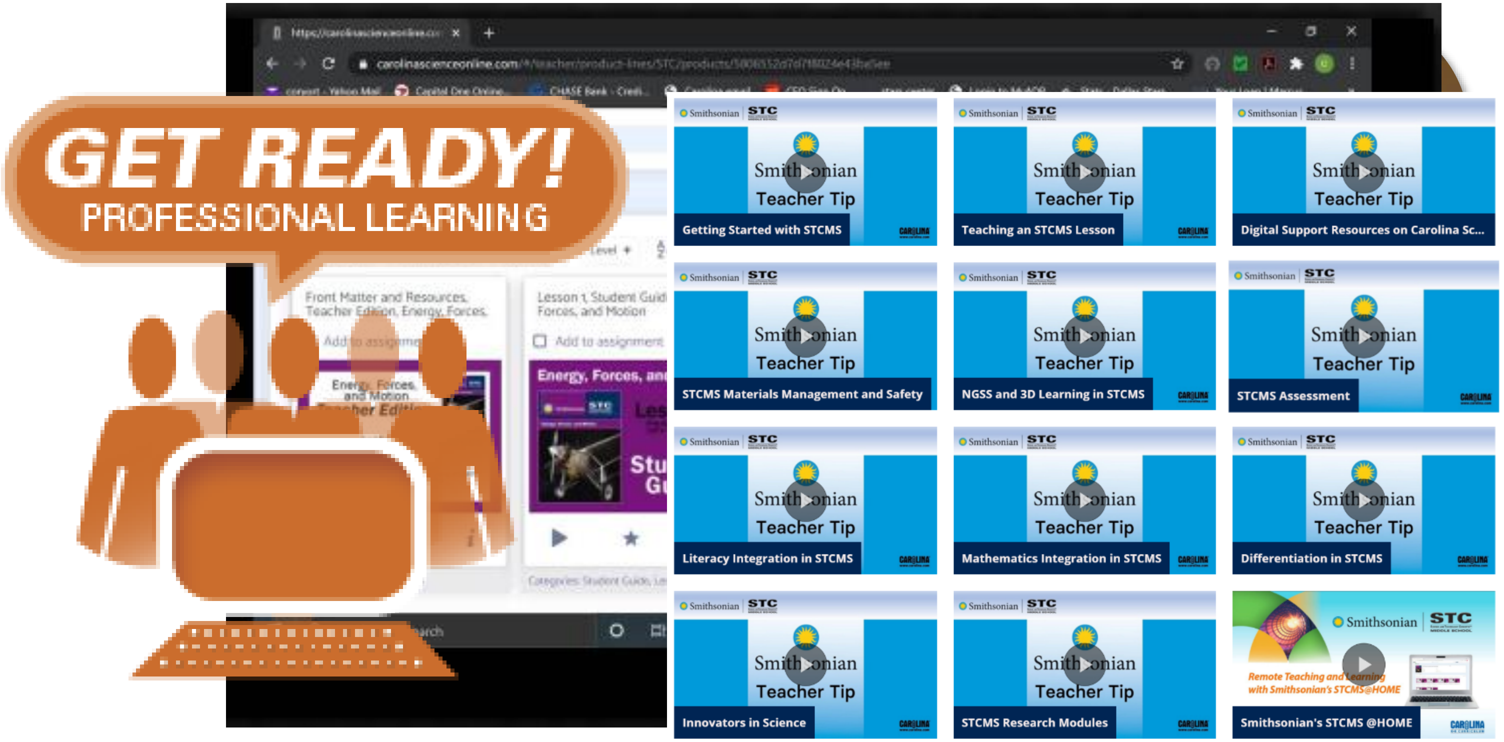
Student Guides
Assessments
Videos

Available:

- English
- Spanish

Teacher Support

Professional Learning



- Provided for the entire life of the adoption
- Trainers that are professional educators
- In-person, virtual, and on-demand

Setting the Standard

- Coherent Storylines
- Proven Results
- Teacher Support

CAROLINA
UNLEASH LEARNING™

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

Science You Can Trust. Results You Can See.