

REAL SCIENCE, REAL LITERACY:

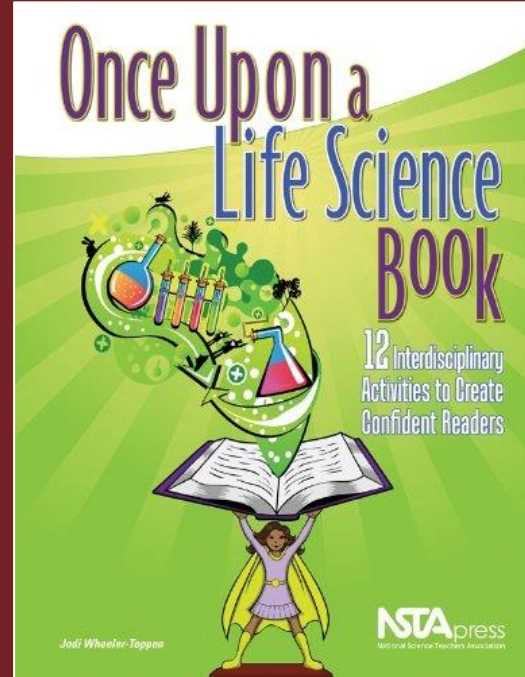
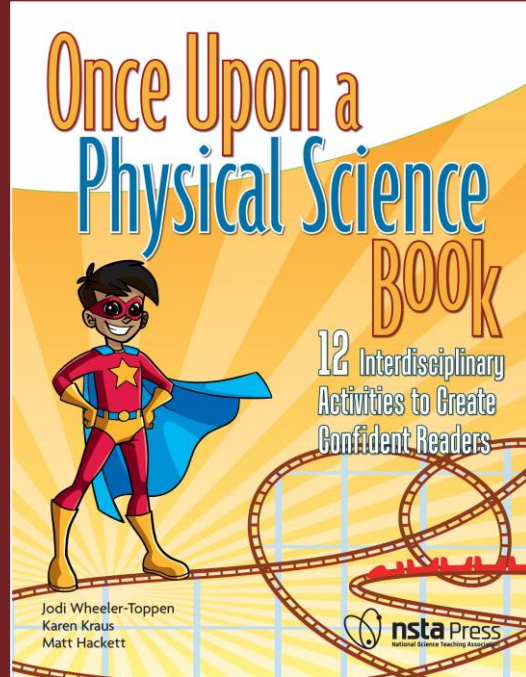
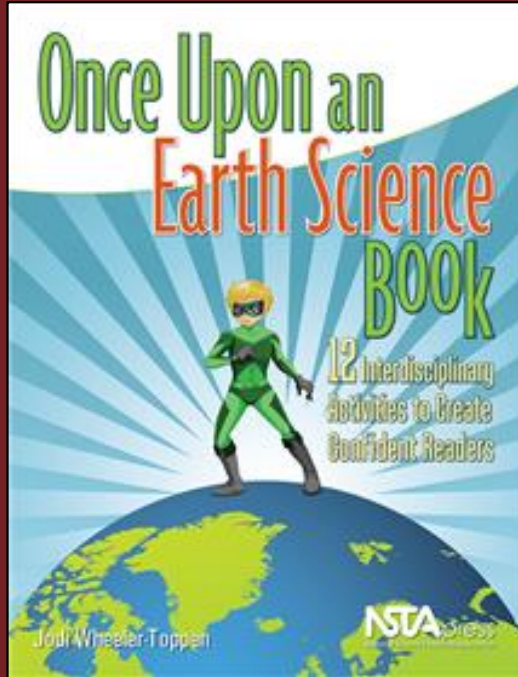
Literacy learning cycles make
reading and writing easier



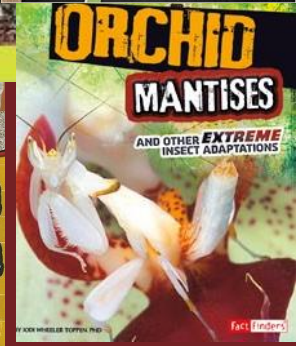
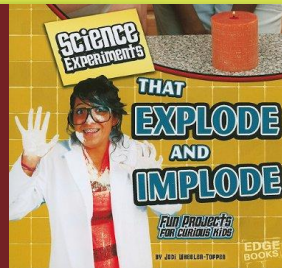
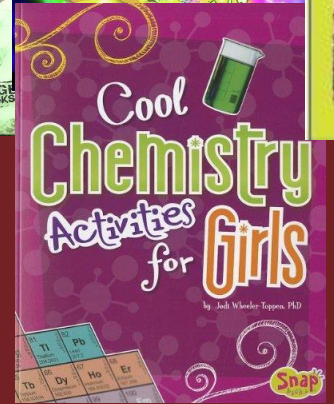
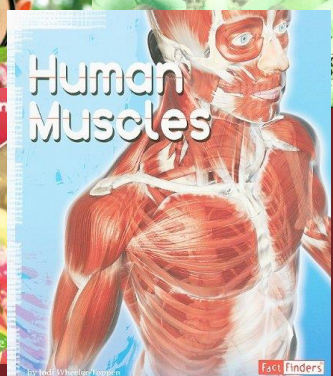
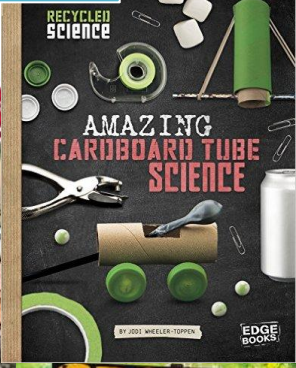
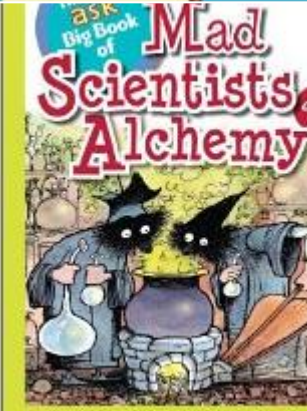
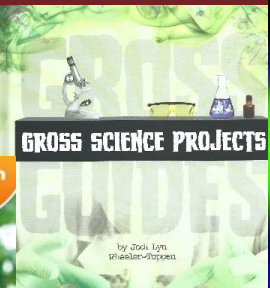
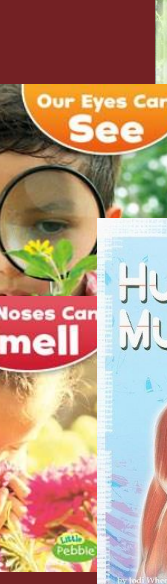
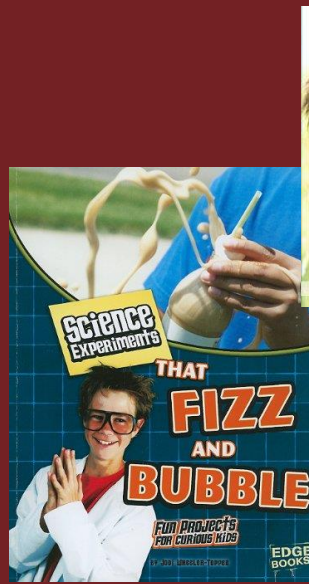
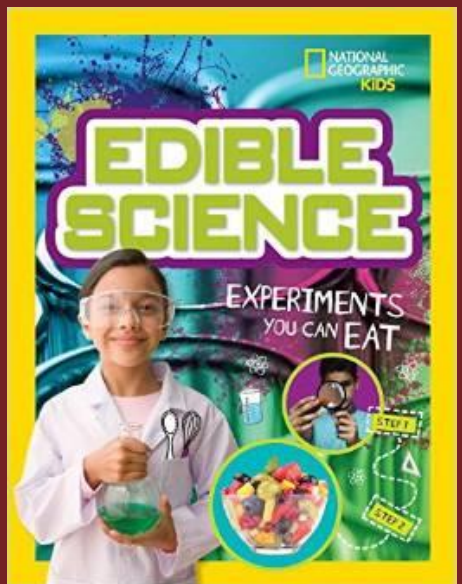
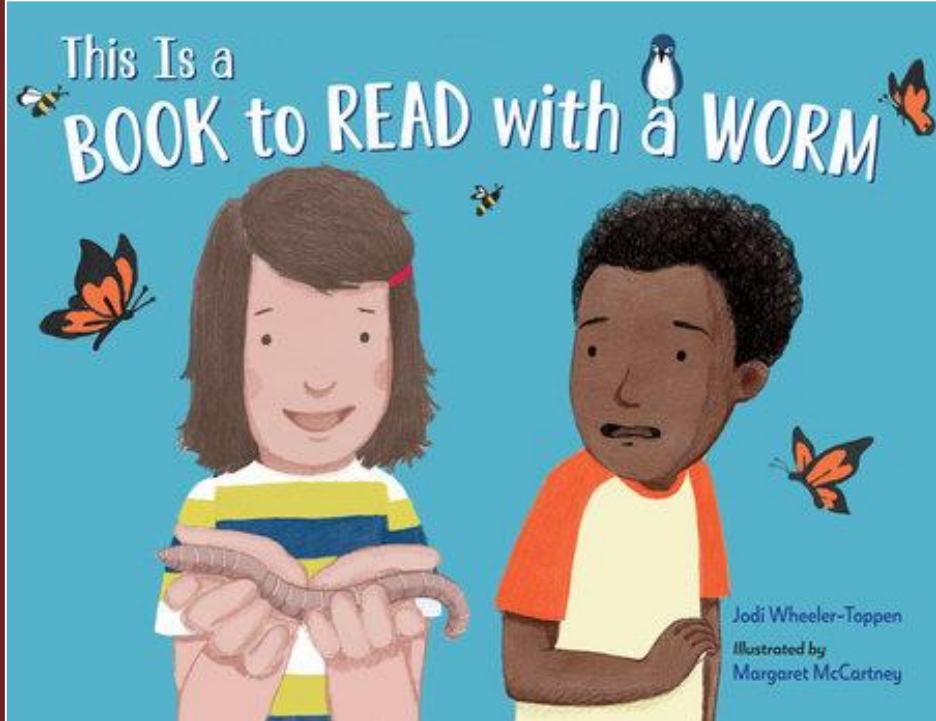
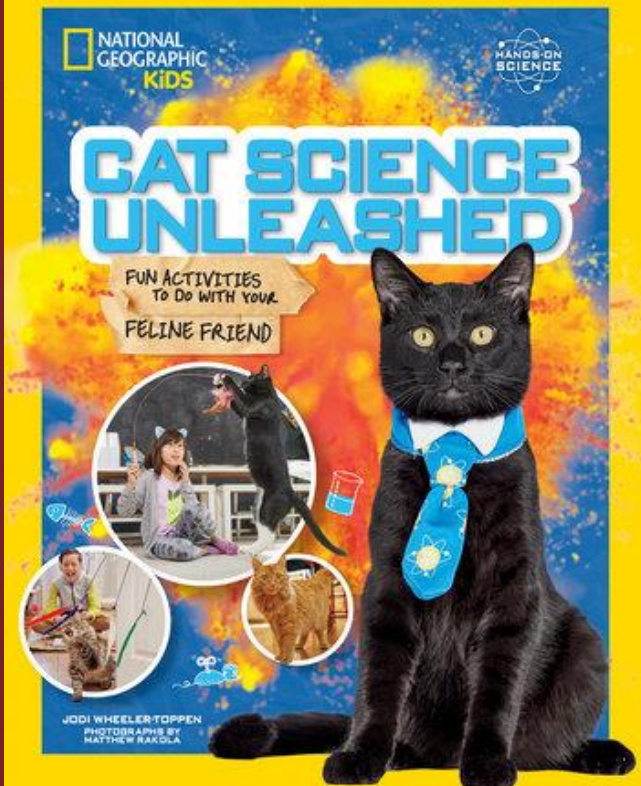
Jodi Wheeler-Toppen, Ph.D.



Read. Write. Science!



Who I am and
How I ended up here



AGENDA

- Walk through a sample lesson set up as a literacy learning cycle
- Discuss why this way of doing things works
- Look at some ways to use mini-lessons to increase the literacy aspect of the lesson



HOW DOES A THERMOMETER WORK? (PHENOMENON)

*Why does the line
get longer when it
gets hot?*



PART 1: HANDS-ON INVESTIGATION

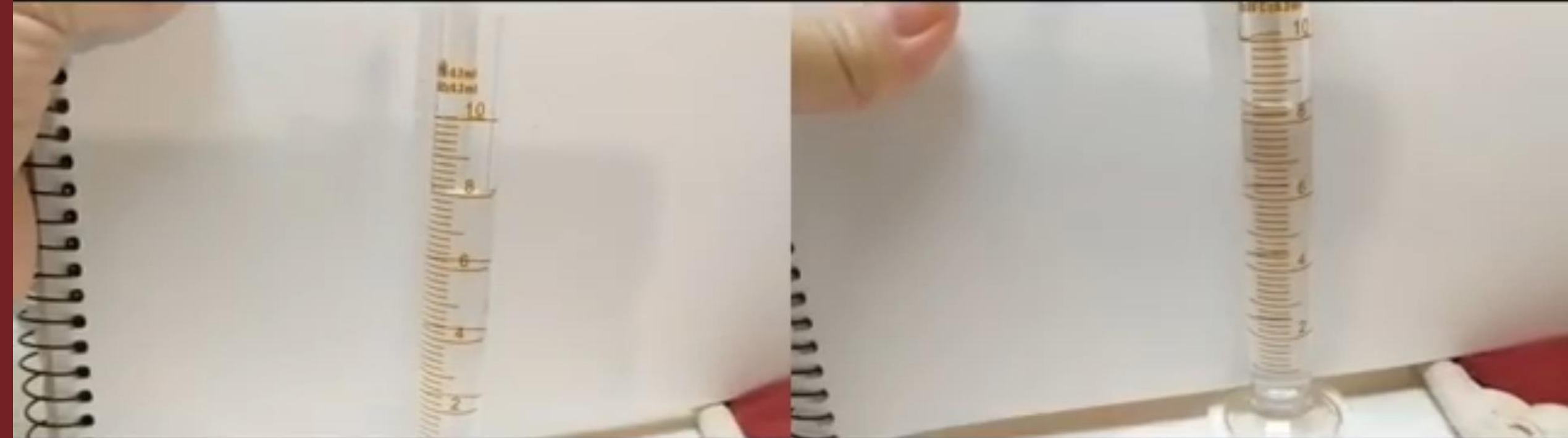
*Adapted from Chapter 10, Once
Upon a Physical Science Book*

LET'S LOOK AT THIS PHENOMENON UP CLOSE:



<https://youtu.be/4S2sQrRU3SU>

WE DIDN'T ADD ALCOHOL. WE DIDN'T TAKE ANY AWAY. SOMEHOW THE SAME AMOUNT OF ALCOHOL GOT BIGGER.



Cold Alcohol

8 mL

Hot Alcohol

8.2 mL

MORE OBSERVATIONS

Cold water on top mixes with hot water below.

Hot water on top stays on top.

What does this suggest about density? What do we know about particles in a dense substance vs. less dense substance?



CHECK OUT THE BEHAVIOR OF FOOD
COLORING MOLECULES DROPPED INTO
WATER OF DIFFERENT TEMPERATURES.



CAN WE MODEL WHAT IS HAPPENING WITH THE FOOD COLORING MOLECULES?



https://youtu.be/_l8jPIRdHPU

PART 2: READING

- We're starting to get clues to make sense of the thermometer. Let's read to find out more.

Feverish

You wake up with a sore throat and a headache. “I’m sick!” you say. “I’m not going to school.” A parent pops a thermometer under your tongue. Your temperature registers 102.5°F. You’re definitely sick. You’re headed to the doctor, not school.

People have known since ancient times that fever is associated with sickness. Doctors in the Roman Empire would feel a patient’s skin and assign a category, such as “hot in the fourth degree.” But the doctors were just guessing. One doctor’s “hot in the fourth degree” might be another doctor’s “hot in the second degree.”

By the Middle Ages, both doctors and scientists had realized it would be useful to have a “ruler” they could use to measure temperature. To build it, they relied on a simple observation: The same amount of matter takes up more space when it is hot than when it is cold.

Thermo (Heat) Meters

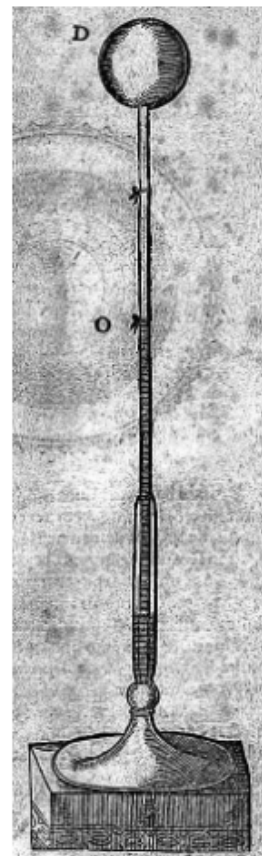
Inventors made the first thermometers from thin tubes, which were marked with lines and set in larger tubes holding water or wine (see Figure S10.1). These devices often had a large, round top filled with air, which patients were sometimes instructed to hold in their mouths. The whole thing could be heated or cooled, causing the liquid to rise or fall accordingly.

At the time, thermometer makers didn’t understand what was happening to cause the change in volume. Now we know that all matter is made up of particles, either atoms or molecules. These particles are always moving. When energy is added to the particles, they move faster. What we call “temperature” is a measure of the average speed of those particles. When you touch something that feels warm, you are feeling the movement of those particles colliding with the particles in your skin.

REMEMBER YOUR CODES

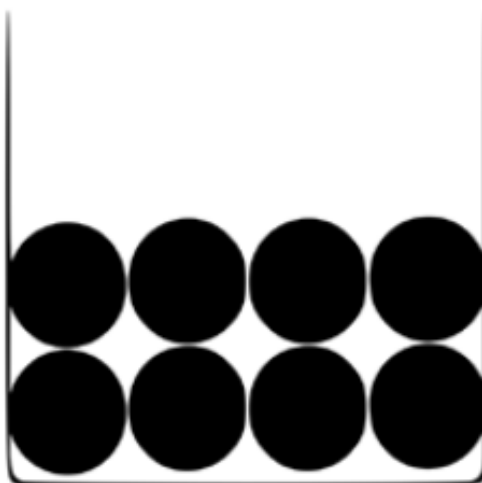
- ! This is important.
- ✓ I knew that.
- X This is different from what I thought.
- ? I don’t understand.

Figure S10.1. Early Thermometer



WE'LL TALK ABOUT THE TEXT AND DO A LITTLE MORE MODELING.

The drawing below shows a group of molecules on the left. Draw molecules in the empty space on the right to show what happens when heat is added.



Add Heat

PART 3: PUT IT ON PAPER (WRITING)

- How does a liquid thermometer work?
Describe what is happening to the molecules of the liquid and how that can be used to show temperature. Include an explanation of what temperature actually measures.

THOUGHTS/OBSERVATIONS ON THIS LESSON?



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QUESTIONS/ OBSERVATIONS ABOUT THIS LESSON?



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Thermometers

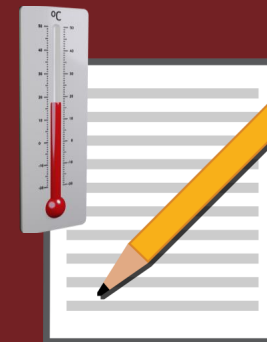
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Figure 510.1 Early Thermometer





Science

Reading

Writing

2. LITERACY LEARNING CYCLES

How this type of lesson is structured (and why!)

LESSON STRUCTURE



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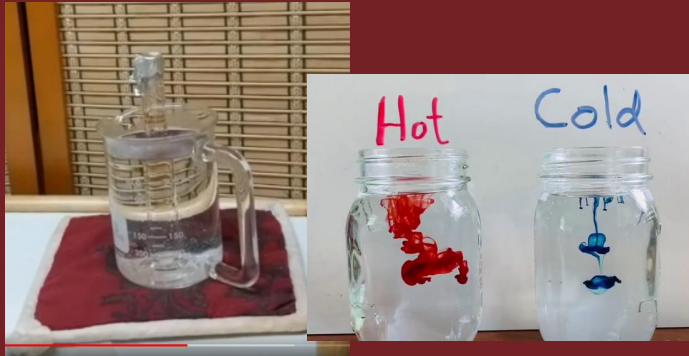
Real Science

Analytical Reading

Academic Writing



WHAT ADVANTAGES ARE THERE TO STARTING WITH HANDS-ON SCIENCE?



- Build background for understanding text
- More likely to approach text in “curiosity mode”
- Allows deeper engagement with the text as it isn’t the “introduction” to the new ideas
- Students have developed “something to say” by the time they need to write

(Engage)

Exploration

Explanation

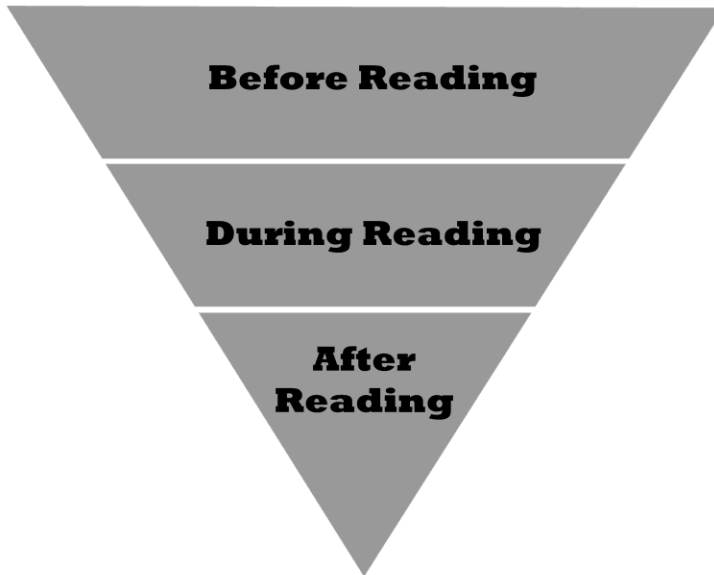
Concept Application

(Evaluate)

+

+

+



=

=

=

Investigate the science concepts and build knowledge needed for the text

Read for clues to what they saw while exploring and for more information

Write to integrate ideas from observations and text

Science Learning Cycle

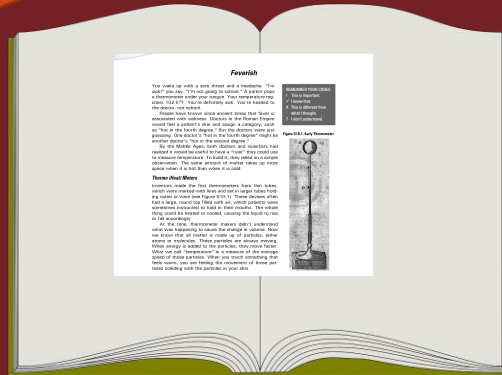
Reading Lesson
(after Berkeley and Barber 2015)

Literacy Learning Cycle

Adding Mini-lessons to a Literacy Learning Cycle

Specific Reading Strategy

Specific Writing Strategy



Real Science

Analytical Reading

Academic Writing



Staff Development Videos



Read. Write.
Science!

Elementary:

- [Integrating Writing and Science](#)
- [Integrating Reading and Science](#)
- [Writing about Claims, Evidence, and Reasoning](#)
- [Sentence Frames for Reading, Writing, and Forming Science Knowledge](#)

Middle/High:

- [Integrating Writing and Science](#)
- [Integrating Reading and Science](#)
- [Signal Words for Reading, Writing, and Forming Science Knowledge](#)
- [Writing about Claims, Evidence, and Reasoning](#)

K-12:

- [Reading Strategies Part 1: Make it Make Sense](#)
- [Reading Strategies Part 2: Problem-Solving Tools](#)
- [Knowing Enough to Read: How Background Influences Science Comprehension](#)
- [Before and After Writing: Prewriting and Evaluation](#)
- [Integrating Reading, Writing, and Science in the K-8 Classroom: A Call to Action for Administrators](#)

THOUGHTS ON LITERACY LEARNING CYCLES

- What makes sense to you in the Literacy Learning Cycle?
- What questions do you have?

Real Science

Analytical Reading

Academic Writing



TEXT DENSITY AND LONG NOUNS

The water is hot.

TEXT DENSITY AND LONG NOUNS

The **water** is hot.

TEXT DENSITY AND LONG NOUNS

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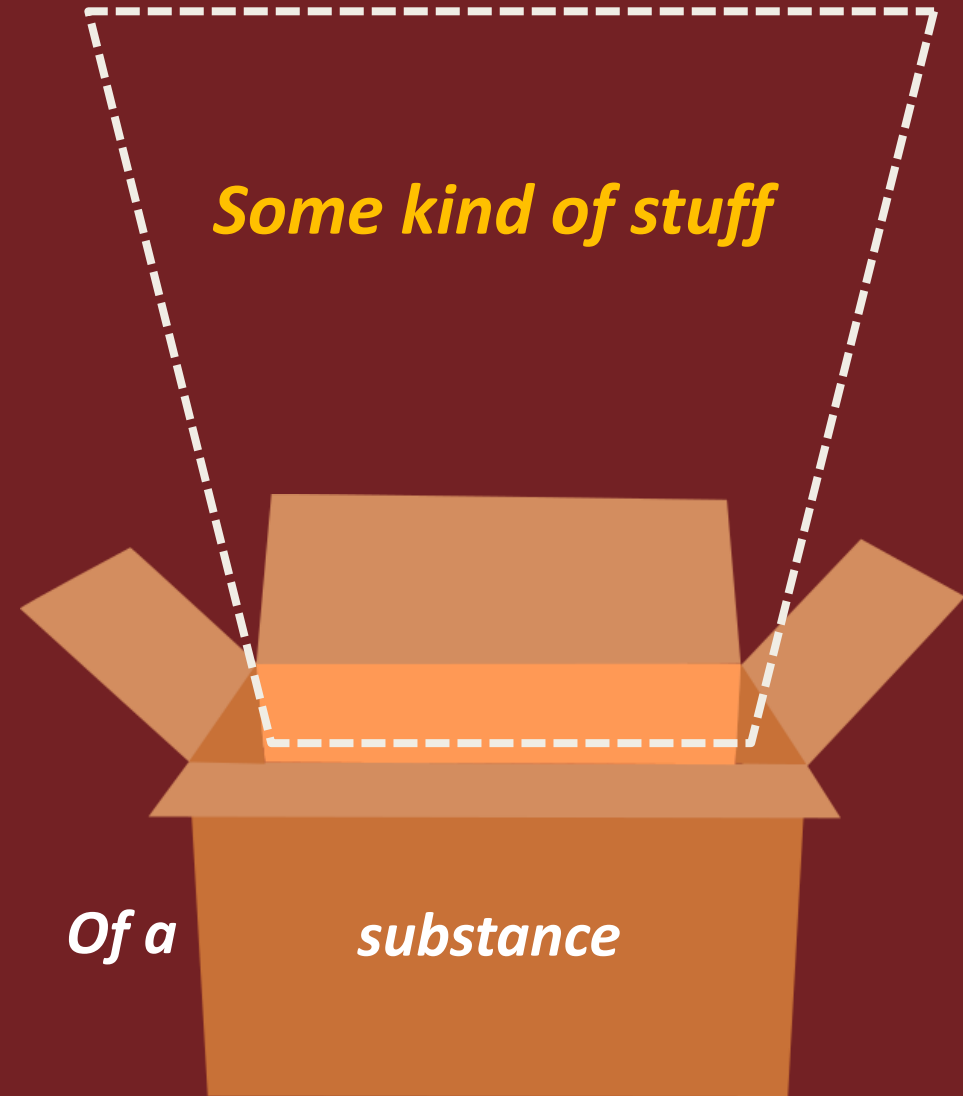
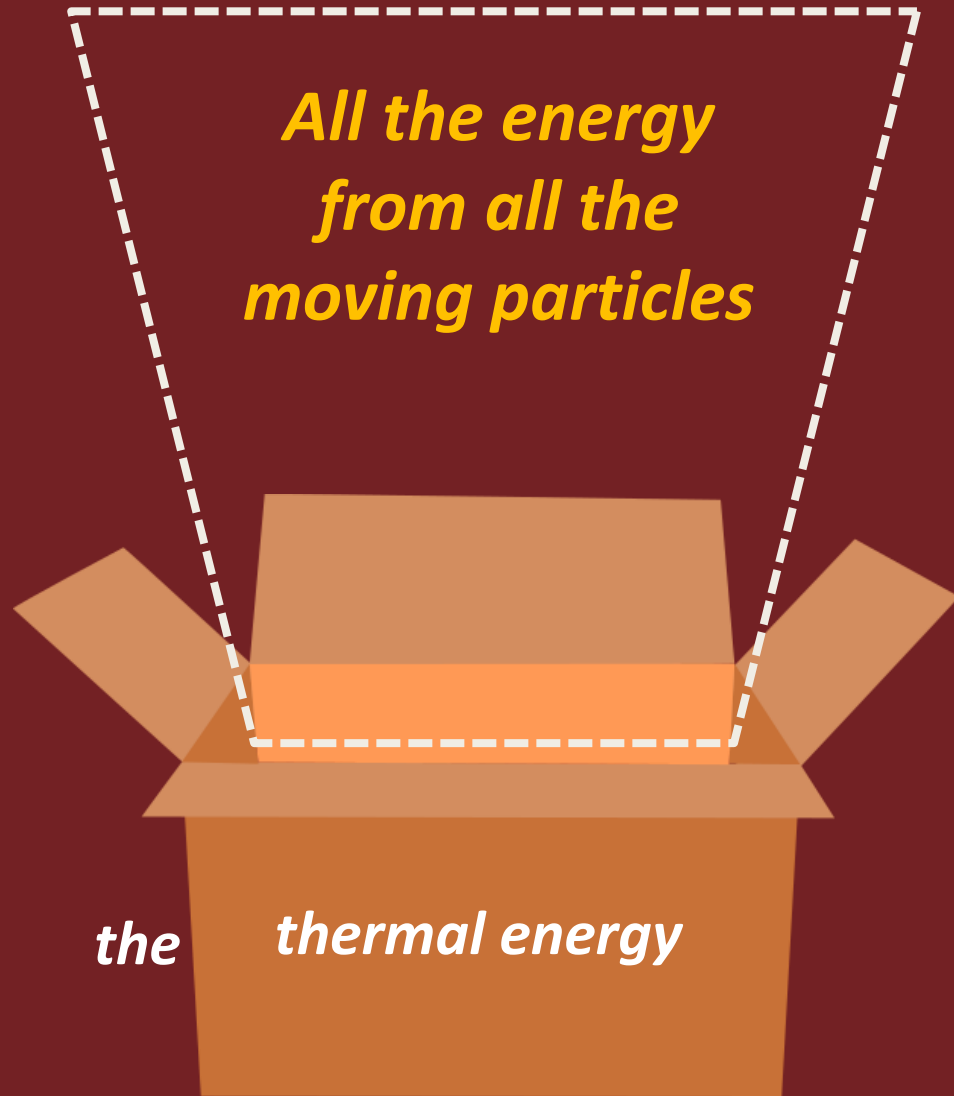
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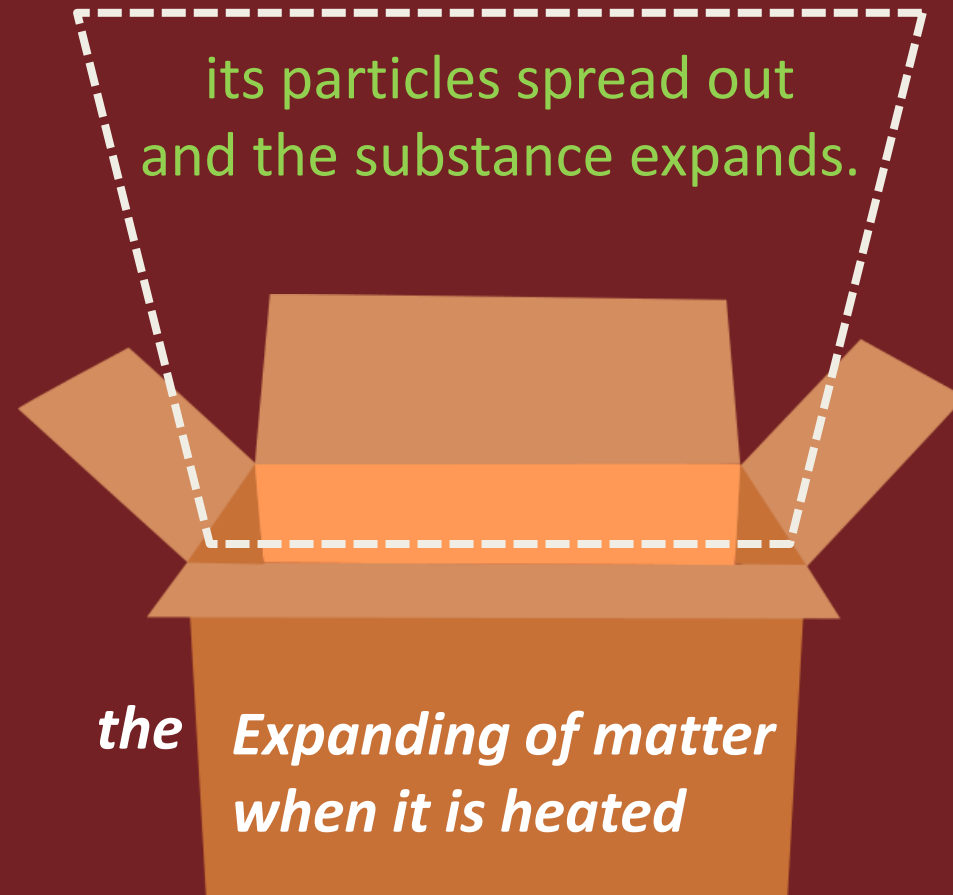
As *the thermal energy of a substance* increases, its particles spread out and the substance expands. *The expanding of matter when it is heated* is known as thermal expansion.

(From Prentice Hall Science Explorer:
Physical Science, 2002. Page 453)



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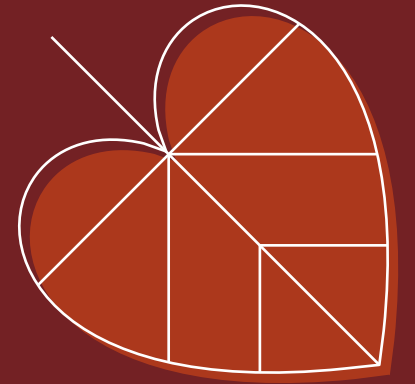
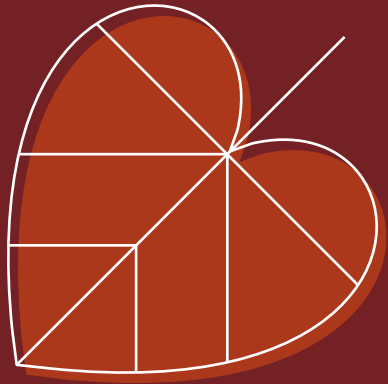


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BEFORE WE LOOK AT STUDENT APPLICATIONS...



- Questions about the linguistics here?
- Do you get this idea of “long nouns”?
- Does it make sense how those nouns can “pack up” information from a previous sentence?



Matter is made up of tiny particles called atoms and molecules. (p436)

The particles that make up a solid are packed together in relatively fixed positions. (p450)

As the thermal energy of a solid increases, **the rigid structure of its particles** begins to break down. (p.451)

WHAT DOES THIS MEAN FOR OUR STUDENTS?

READING MINI-LESSONS

- **Chunking mini-lesson**

Explain to students that science writing can have a lot of ideas crammed into just a few words. We often have to break it down into “chunks” to think it through, bit by bit.

A well-insulated thermos / with both trapped air / and a vacuum / is effective at / stopping heat transfer.

- **What is a long noun? mini-lesson**

Pull from sample sentences from a text you are reading. Underline the long nouns and just let students see how they can find the main word and then think through all the surrounding information.

- **Finding long nouns mini-lesson**

Pull sample sentences from a text and challenge students to find the long noun in each sentence.

WHAT DOES THIS MEAN FOR OUR STUDENTS? WRITING MINI-LESSON

- Writing long nouns mini-lesson

Put some less-than-complete sentences from student writing up and have students offer information that could be packed into the noun to make it more complete.

WHY DID THE FOOD COLORING SPREAD OUT FASTER IN HOT WATER THAN IN COLD WATER.

The **particles** move faster so they mix up faster.

What are the important features of these particles?

hot, in the water, also in the food coloring,

The **hot particles in the water and food coloring** move faster (**than the cold particles**) so they mix up faster.

Once Upon an Earth Science BOOK



12 Interdisciplinary
Activities to Create
Confident Readers

Jodi Wheeler-Toppen

NSTApress
National Science Teachers Association

Once Upon a Physical Science BOOK

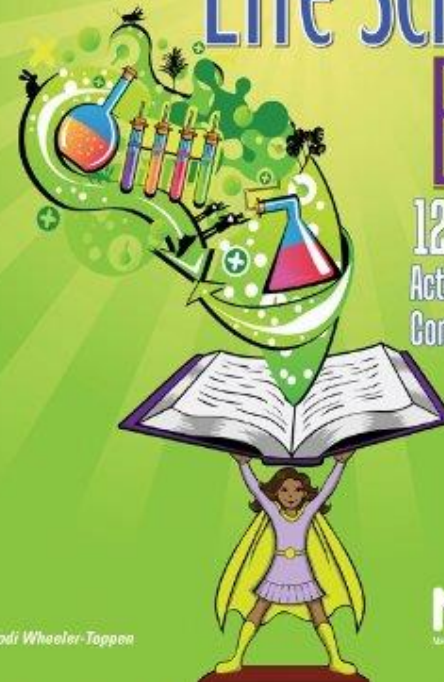


12 Interdisciplinary
Activities to Create
Confident Readers

Jodi Wheeler-Toppen
Karen Kraus
Matt Hackett

nsta Press
National Science Teaching Association

Once Upon a Life Science BOOK



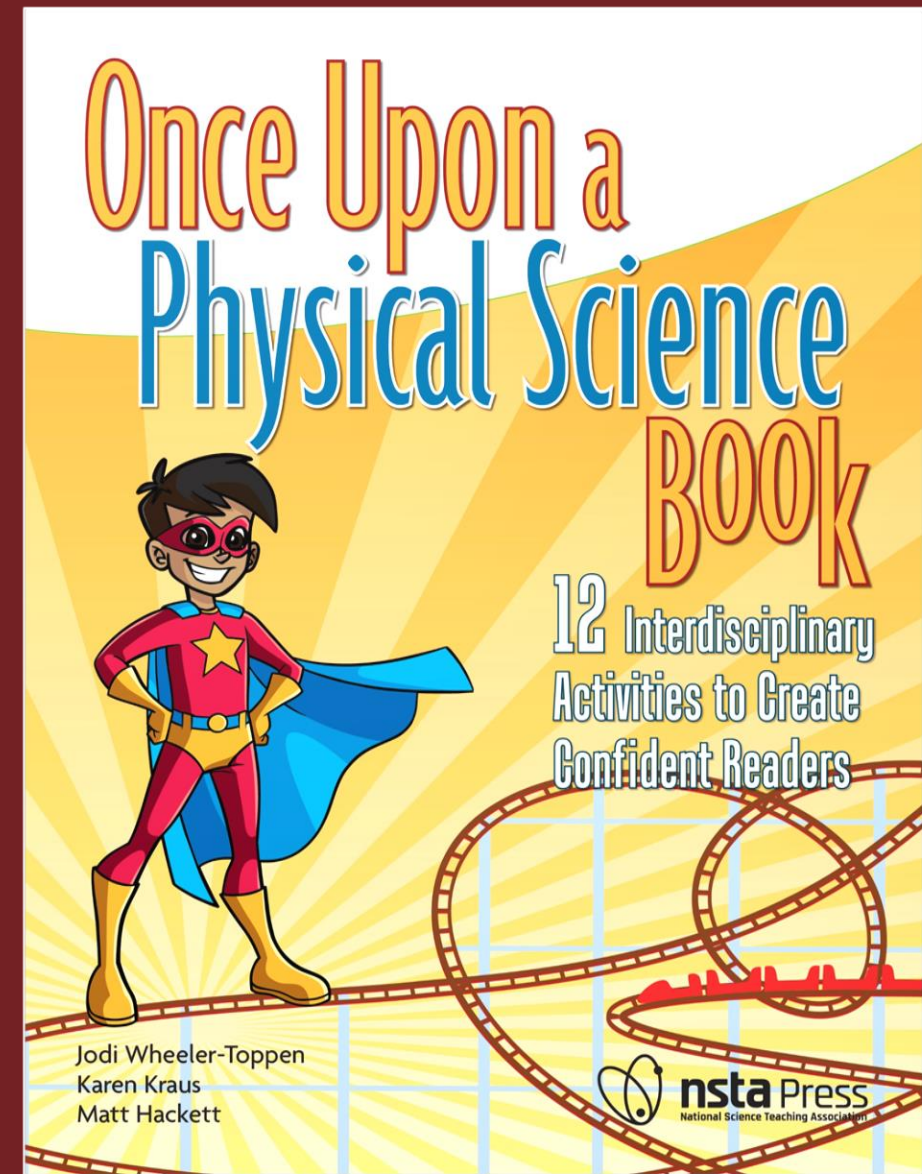
12 Interdisciplinary
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NSTApress
National Science Teachers Association

Each chapter includes:

- A hands-on exploration
- An engaging article to read, paired with
 - An appropriate reading strategy and instructions for introducing it
 - A short journal question about the strategy
- A writing prompt that draws from the exploration and the reading
- A “Thinking Mathematically” or “Thinking Visually” activity



THANK YOU!

And feel free to reach out with further thoughts or questions:

wheelertop@gmail.com

<https://OnceUponaScienceBook.com/>