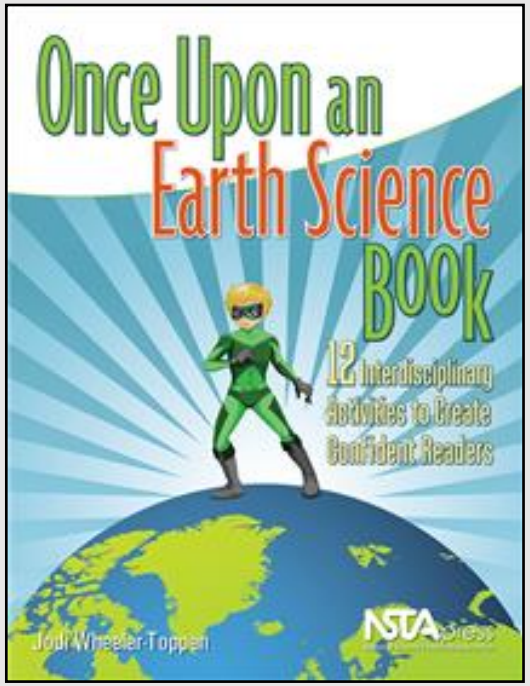
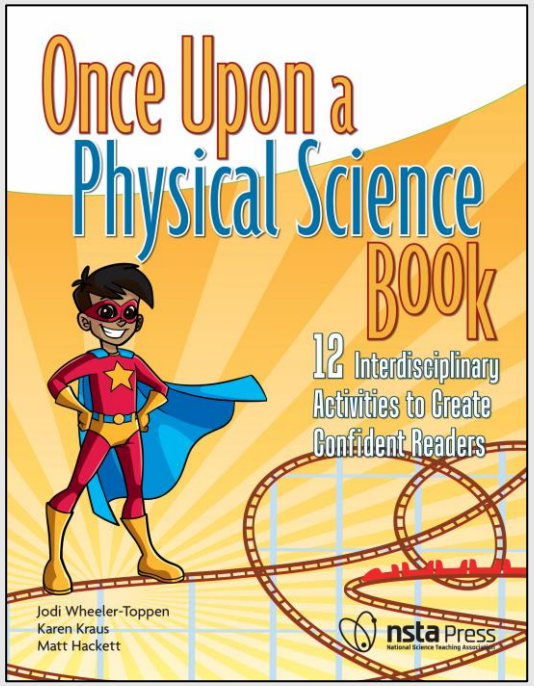
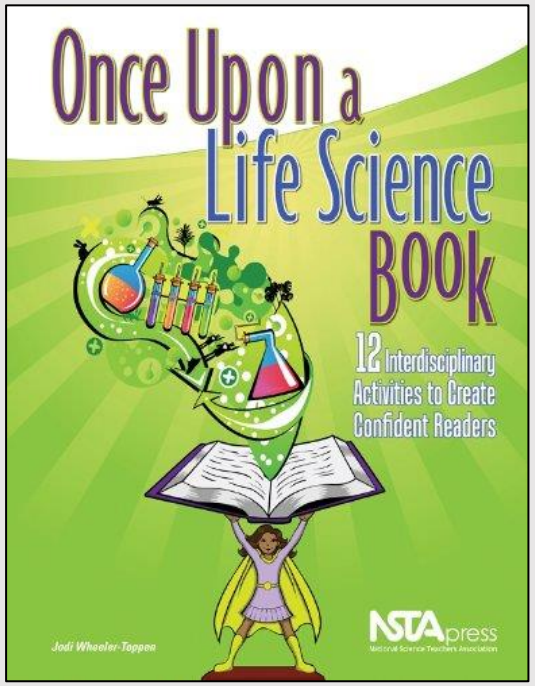
Once Upon a Physical Science Book: Real Science, Real Literacy

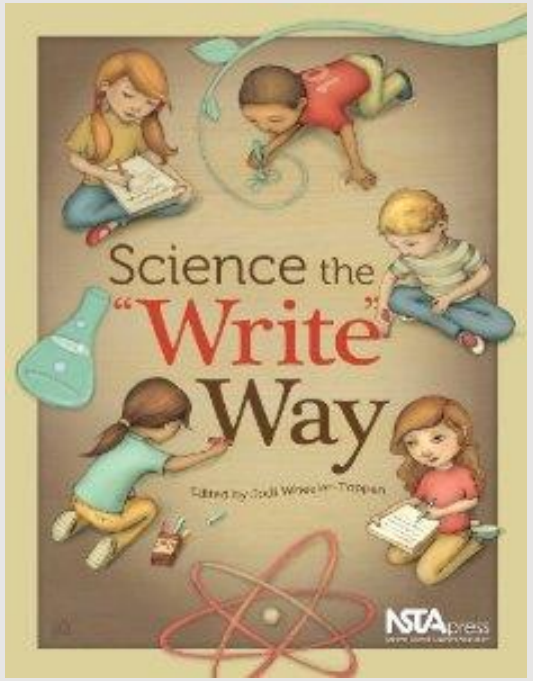
Jodi Wheeler-Toppen, Ph.D.

Read. Write. Science!







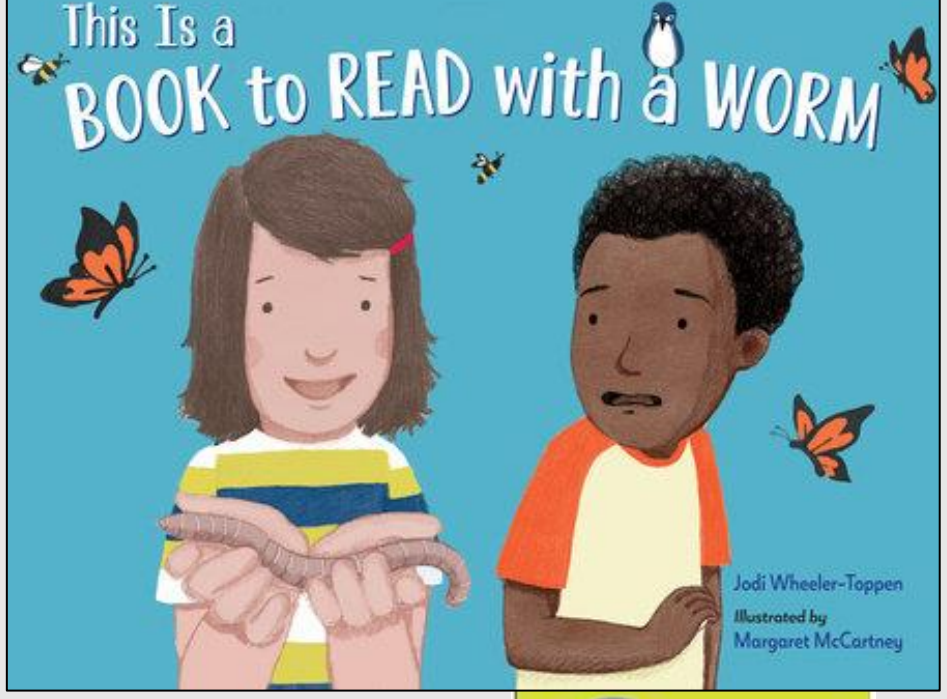


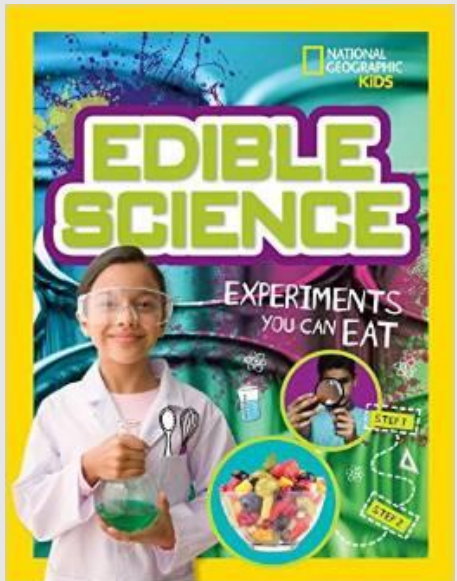
Who I am and

How I ended up here


NATIONAL GEOGRAPHIC KIDS
DOG SCIENCE UNLEASHED
FUN ACTIVITIES TO DO WITH YOUR CANINE COMPANION
JODI WHEELER-TOPPEN


NATIONAL GEOGRAPHIC KIDS
HANDS-ON SCIENCE
CAT SCIENCE UNLEASHED
FUN ACTIVITIES TO DO WITH YOUR FELINE FRIEND
JODI WHEELER-TOPPEN
PHOTOGRAPHS BY MATTHEW RAKOLA

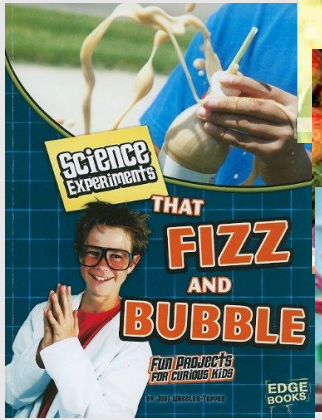

This Is a
BOOK to READ with a WORM
Jodi Wheeler-Toppen
Illustrated by
Margaret McCartney


NATIONAL GEOGRAPHIC KIDS
EDIBLE SCIENCE
EXPERIMENTS YOU CAN EAT


Our Ears Can Hear


Our Eyes Can See

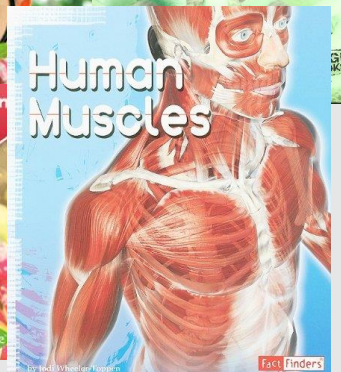

Our Mouths Can Taste


Science Experiments
THAT FIZZ AND BUBBLE
FUN PROJECTS FOR CURIOUS KIDS
EDGE BOOKS


Our Skin Can Touch


Our Noses Can Smell


GROSS SCIENCE PROJECTS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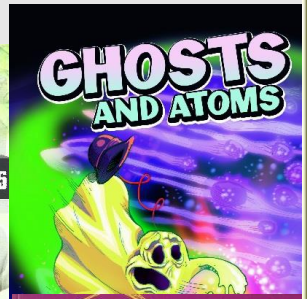
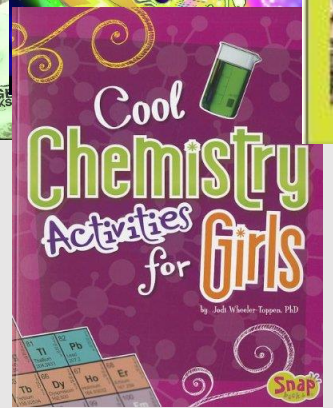
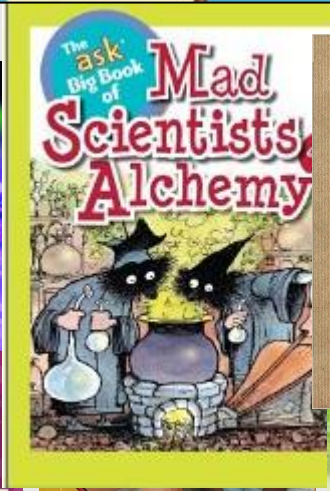
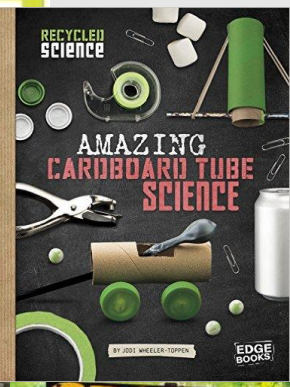
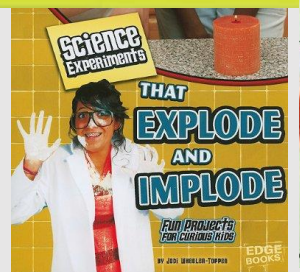
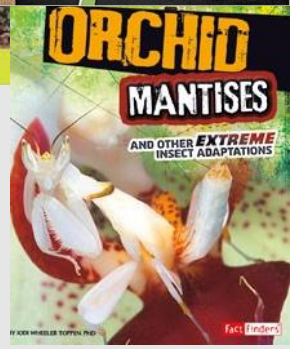

GHOSTS AND ATOMS


Cool Chemistry Activities for Girls


The ask Big Book of Mad Scientists Alchemy


RECYCLED SCIENCE
AMAZING CARDBOARD TUBE SCIENCE
EDGE BOOKS


Science Experiments
THAT EXPLODE AND IMPLODE
FUN PROJECTS FOR CURIOUS KIDS
EDGE BOOKS


ORCHID MANTISES
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Agenda

- Skip through a couple of “Literacy Learning Cycles”
- Talk about how this type of lesson is structured (and why!)
- Dig in on reading challenges
- Find out about available resources to support this style of teaching

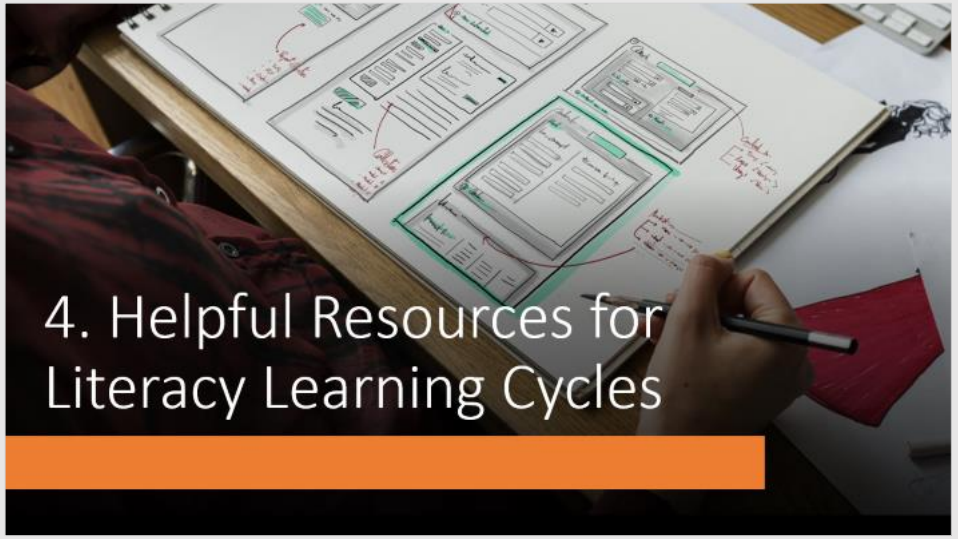
Agenda

1. Literacy Learning Cycle:
   Inertia: It's a Drag
   Chapter 7: Once Upon a Physical Science Book

Science Reading Writing

2. Literacy Learning Cycles
   How this type of lesson is structured (and why!)

3. Digging Deeper on Reading: Three Impediments to Learning from Text



1. Literacy Learning Cycle:

Inertia: It’s a Drag

Chapter 7: Once Upon a Physical Science Book

Phenomenon:

Have you ever been riding in a car or bus and felt yourself leaning in some direction? Having a hard time sitting upright?

Today we’re going to explore some ideas to help us explain why that happens.

Part 1: Explore
Take your marble on a magic carpet ride...

- Put your marble in the middle of the card. Pull the card as quickly as you can in a straight line while keeping the ball in the middle. See how quickly you can pull it to the end of your table.

  What happened to the ball if you pulled the platform too fast?

- Get the card and ball moving again in a straight line. Change the direction that the card is moving as quickly as you can without losing the ball. You can choose to turn right or left.

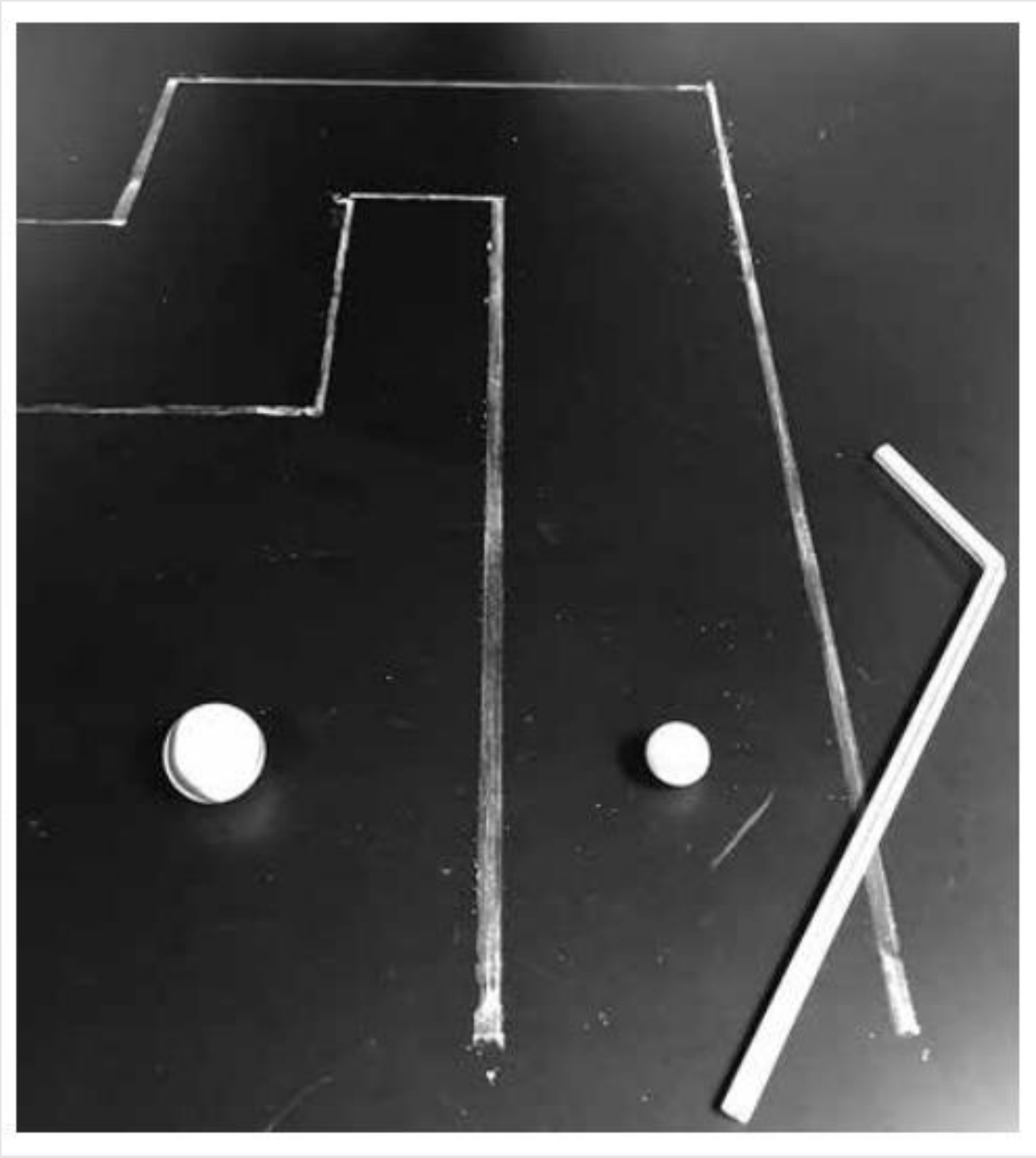
  What did the ball do if the turn was too fast?

- Get the platform and ball moving as fast as you can and stop it as quickly as you can.

  What did the ball do if you stopped the platform too quickly?

Marble Maze

- Work with your team to move the marble through the maze.
- Try again with the heavier marble. How do you have to adjust your strategies?

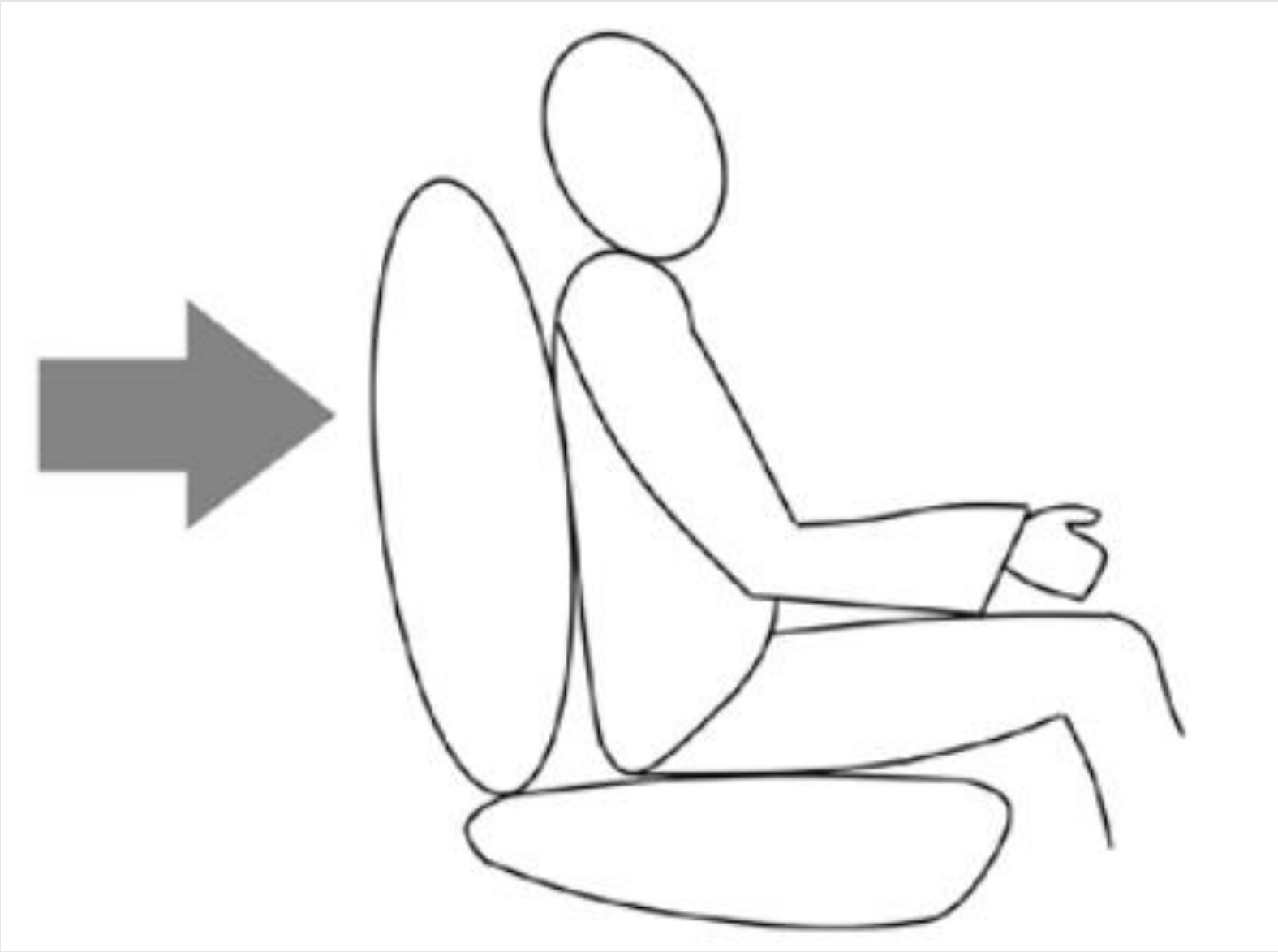


Part 2: Read!

- We are going to read an article that will talk about what happens as you ride in a vehicle.

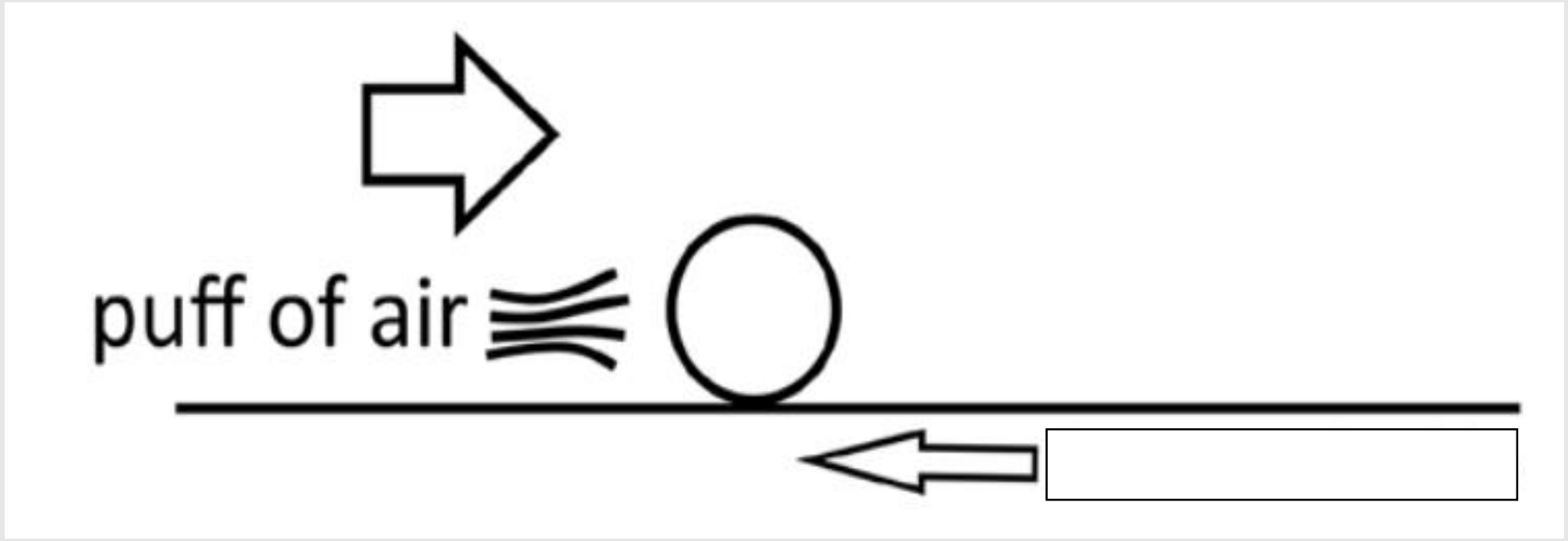
- Before we read, let's preview some of the diagrams from this text. (reading strategy)

- Grab a partner. Decide who is going to be Partner 1 and who will be Partner 2.



Partner 1: Describe what you see in this diagram.

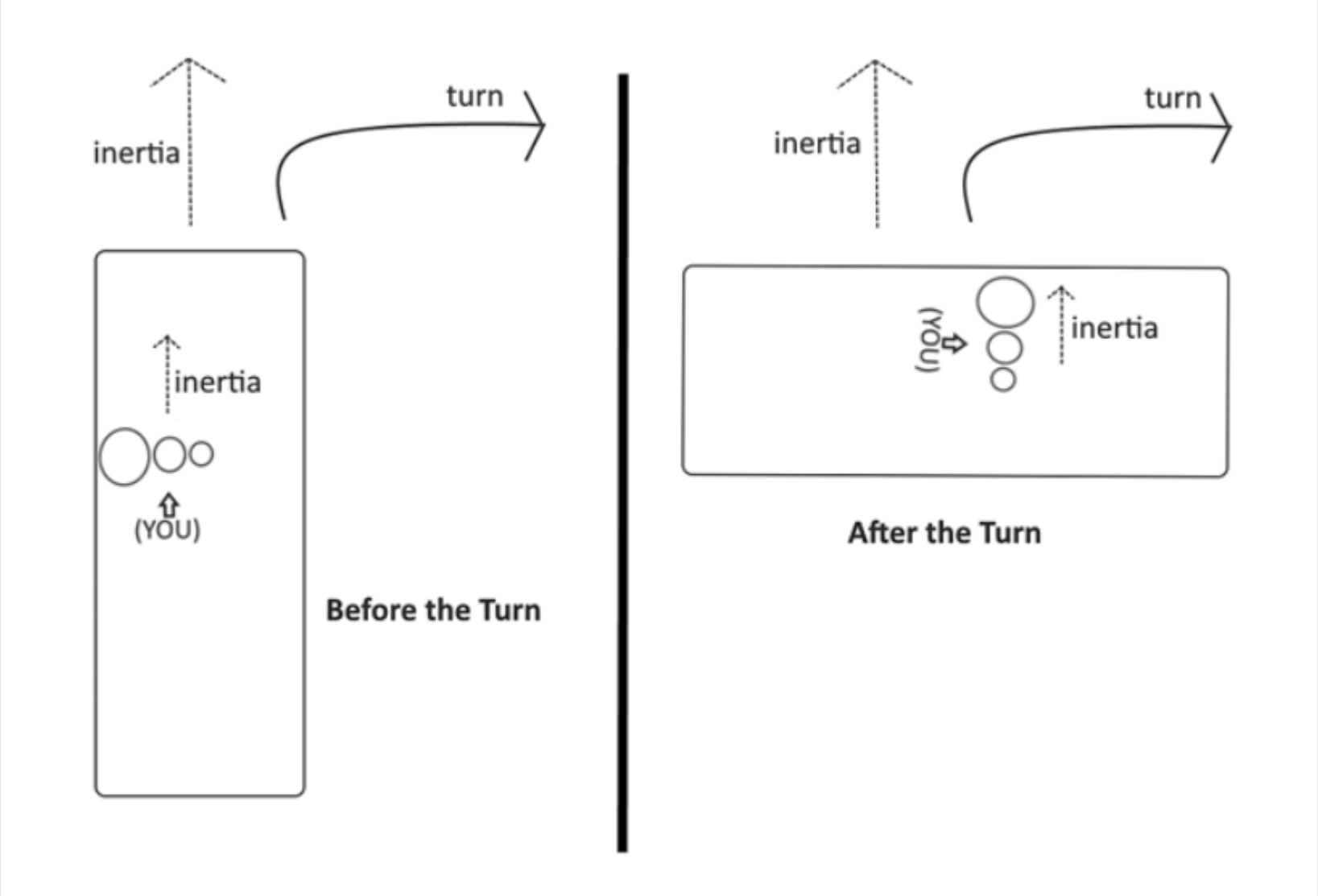
Partner 2: Make a prediction. What do you think this has to do with the activity we just did?



- Partner 2: Describe what you see in the diagram.

- Partner 1: Make a prediction. What do you think the label under the rectangle says?

- Partner 1: Describe what you see in the diagram.
- Partner 2: Make a prediction. What idea do you think this diagram is trying to show?



One Long Bus Ride

Field trip to the science museum! You load onto the school bus, packed three to a seat. You find yourself wedged between Football Fred, the biggest student in your class, and Tiny Tiana, the smallest. Ms. Wheeler is driving. You groan. Ms. Wheeler has only been driving buses for a few weeks, and she's not exactly smooth at the wheel.

"Hang on!" she cries as she hits the gas. The bus leaps out of its parking spot. As the bus plows forward, you lean back hard, feeling as though you were being pressed to the back of your seat. The bus races for the end of the parking lot, then—*screech!*—Ms. Wheeler hits the brakes. You barely stop yourself from banging your face on the back of the seat in front of you.

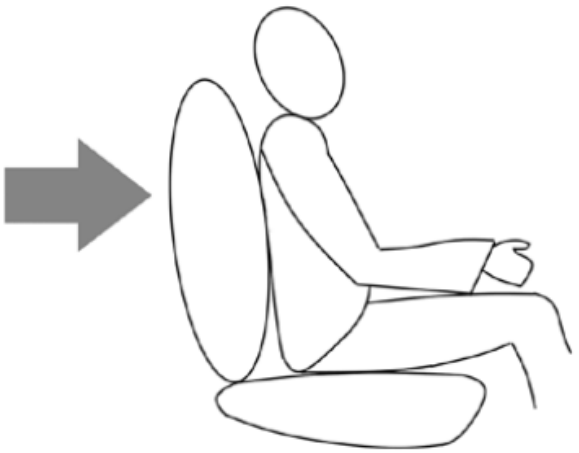
REMEMBER YOUR CODES

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

Things Keep Doing What They Are Doing

Why all the lurching back and forth? You can thank inertia. Inertia describes how objects resist changing speed or direction. Before the bus started, you were sitting still in your seat. The bus moved forward, but your body resisted getting moving. That's inertia. The back of your seat had to push you forward to help you get with the program, as seen in Figure S7.2. Once your body was moving along with the bus, it was ready to continue moving forward. When the bus stopped suddenly, your body kept going, propelling your face toward the seat in front of you. That's also inertia.

Figure S7.2. Inertia as the Bus Speeds Up

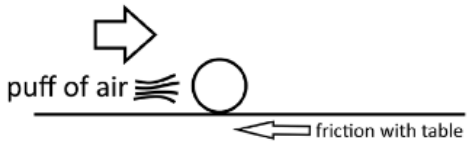


The bus pushes against you as it starts forward.

Isaac Newton, an early physicist, described inertia this way in his first law of motion: An object in motion remains in motion, and an object at rest remains at rest, unless acted upon by an external force. Imagine that you set a marble on a smooth table. As long as you don't touch it or blow on it or tilt the table, it is going to sit in that same spot. It is "at rest," and it is going to stay that way. But say you take a deep breath and blow on the marble. Now you have applied an outside force that is strong enough to overcome the marble's inertia. The marble starts rolling forward, and it will keep rolling forward, even if you don't puff on it again. This time, its inertia keeps it moving.

If you have a long enough table, the marble will eventually stop—not because of some failure of inertia, but because there is a small force still acting on the marble. That force is friction, as shown in Figure S7.3. Friction between the marble and the table gradually slows the marble.

Figure S7.3. Friction Gradually Slows the Marble

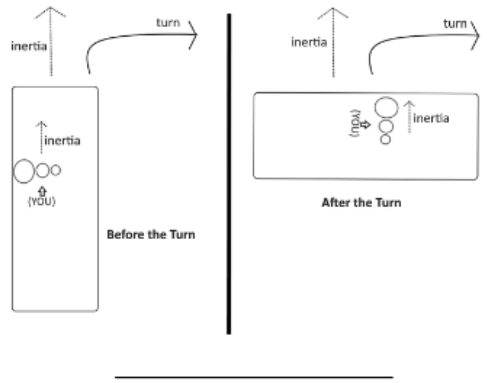


Taking Inertia for a Spin

Back on the bus, you're bracing yourself to try to limit the effects of inertia. "Oh! I almost missed my turn," shouts Ms. Wheeler, as she wrenches the bus to the right. You find yourself leaning left against Football Fred, who leans against the window. At the same time, Tiny Tiana falls over onto you. Why, when the bus turned *right*, did you and your seatmates fall *left*?

Once again, the answer is inertia. See Figure S7.4. Before the turn, you and Tiana were moving steadily forward. When the bus turned, you kept moving in that same direction. But because of the turn, Football Fred was sitting where "forward" used to be!

Figure S7.4. Inertia as the Bus Turns



Get the complete article here:

https://wheelertoppen.files.wordpress.com/2023/03/one-long-bus-ride.pdf

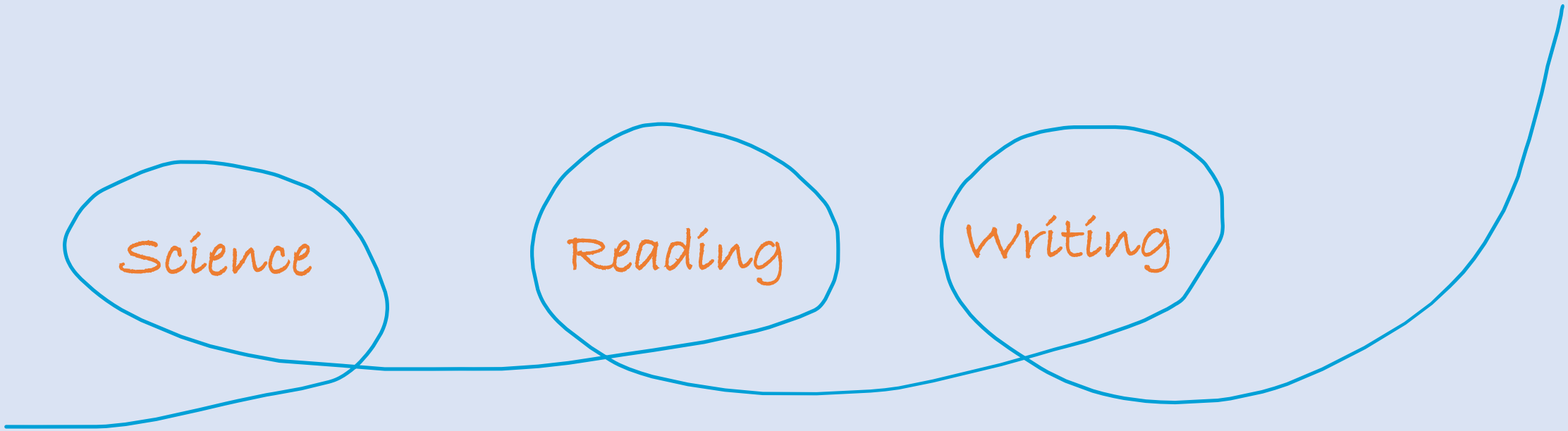
Part 3: Writing Prompt

When the ketchup level in a bottle gets low, people will often solve the problem by turning the bottle upside down, giving it a hard shake, and then stopping the bottle suddenly.

Explain why this can get the ketchup to the end of the bottle.

Pre-writing Questions

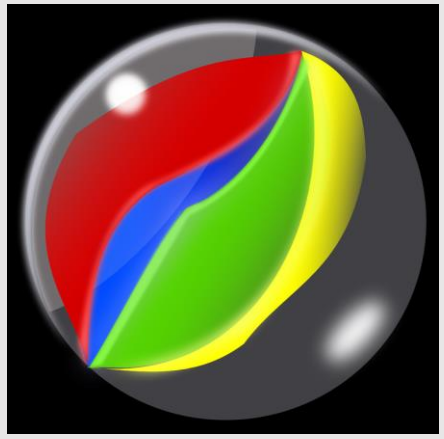
- Which step in the marble/card activity was most like this situation? (Think about this as you work on your response).
- What science words do you think you should include in your response?
- A diagram often makes an explanation clearer. Think about a diagram you could draw to add to your explanation. How would you direct your reader to refer to it?

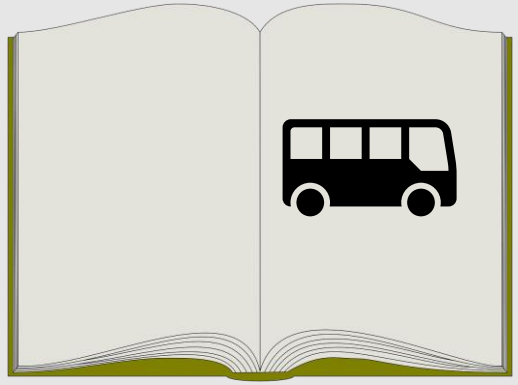


2. Literacy Learning Cycles

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

Lesson Structure





Real Science Analytical Reading Academic Writing

(Engage)

Exploration

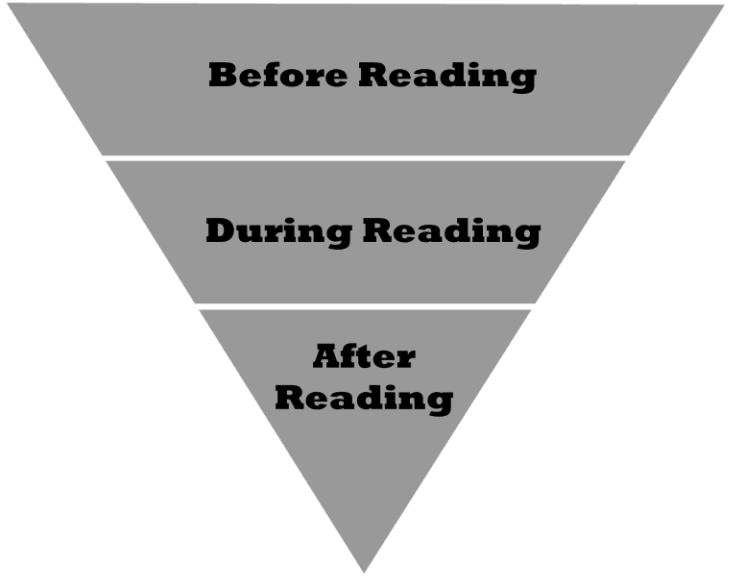
Explanation

Concept Application

(Evaluate)

Science Learning Cycle

+



Reading Lesson

(after Berkeley and Barber 2015)

=

Investigate the science concepts and build knowledge needed for the text

=

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

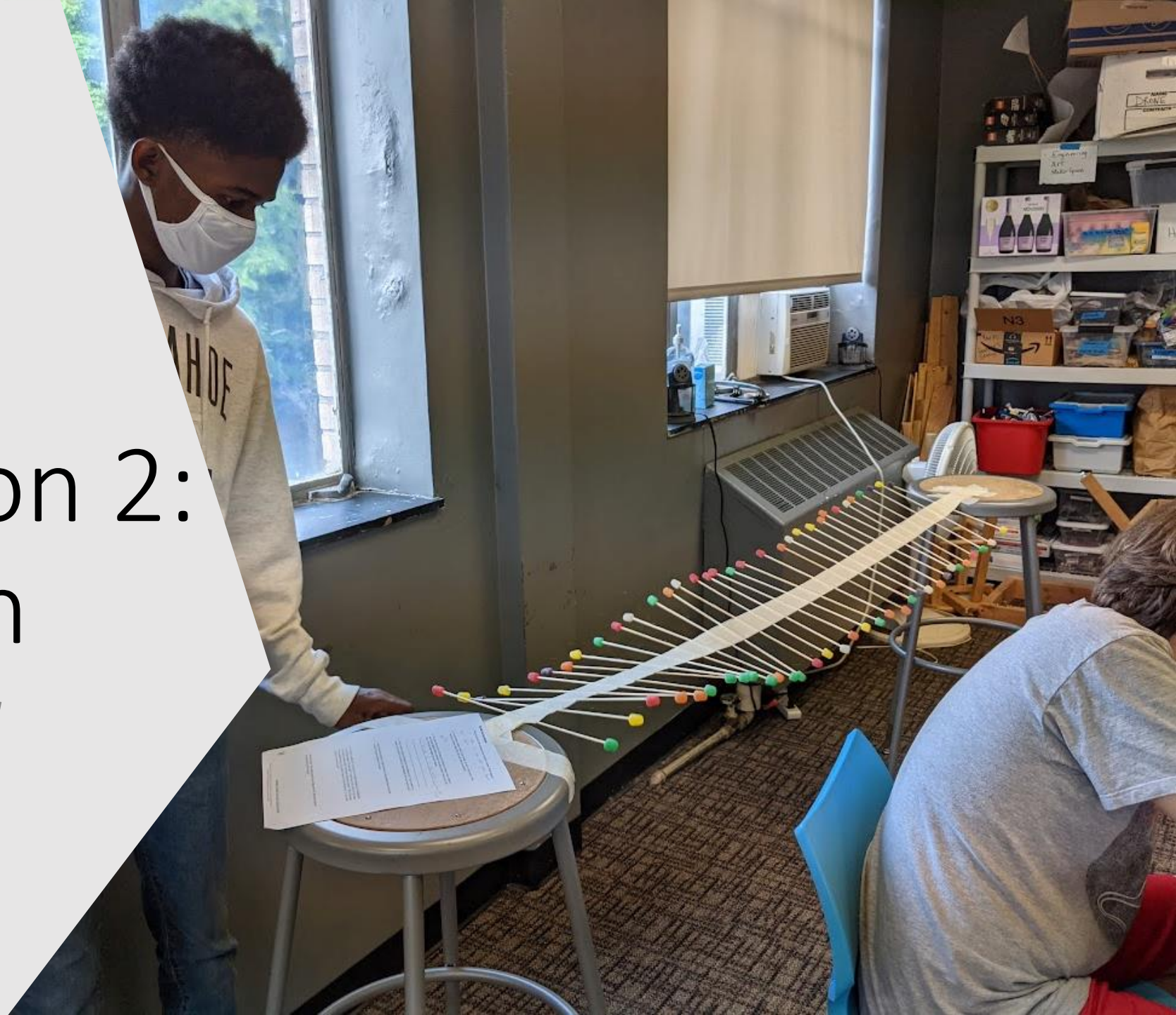
=

Write to integrate ideas from observations and text

Literacy Learning Cycle

Sample Lesson 2: Wave Motion

Chapter 13 of *Once Upon a Physical Science Book*



Instructions to build wave machines

- https://wheelertoppen.files.wordpress.com/2023/10/wave-machine-instructions.pdf

Part 1a: Explore the wave machine

(p. 187-189)

1. Walk to one end of the machine and tap the side of a skewer. What happens?

2. Let the machine settle so that it stops moving. Are any of the parts of the machine in a different place than they were when you started?

3. The motion that you saw move along the machine is called a wave. Spend a few moments tapping different skewers to see what kinds of waves you can make. Write three observations from your tapping.

4. Use your hands to steady the skewers so the machine is still. Tap the side of a skewer at the far end of the machine. In which direction did your wave travel?

5. Watch the candies carefully. In which direction do the candies move? Are they moving in the same direction as the wave?

Part 1b: Explore the wave machine

(p. 187-189)

6. The individual candies don't move very far, at least compared to the distance that the wave travels. The tape doesn't move much at all. And all the parts of your wave machine return to the place where they started. That's because the wave carries energy, not particles.

Based on this information, try to write a definition for the word wave:

7. Start a new wave. Then make a second wave chase the first. Does the second wave ever catch the first wave?

8. Experiment until you figure out how to make bigger and smaller waves. How do you do it?

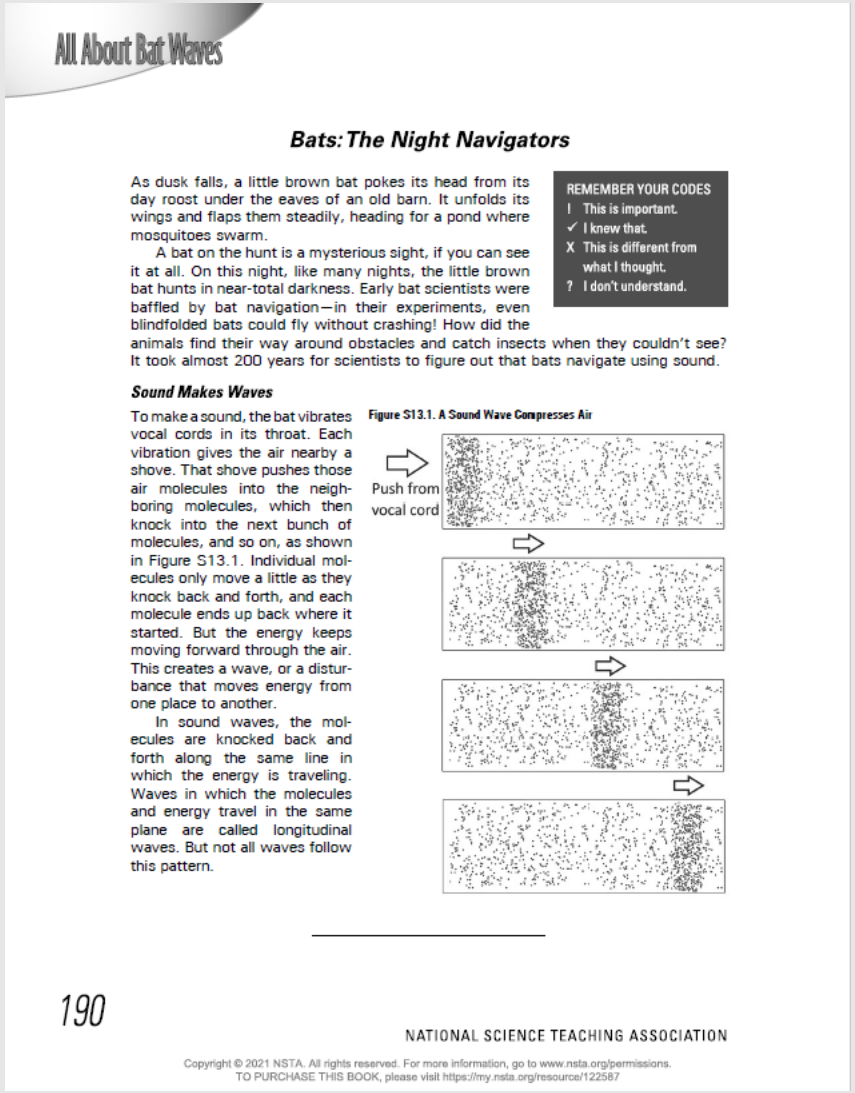
9. Each time you send a wave down the machine, you are moving energy from one end to another. Which sends more energy, a big wave or a small wave?

10. An individual wave can only get so big. Given that each wave is limited in size, how can you send more energy across the machine?

Part 2: Learn About Waves

- Article on pages 190-192 (Chapter 13)

- Or at this link: https://wheelertoppen.files.wordpress.com/2023/10/bats-the-night-navigator.pdf



All About Bat Waves

Bats: The Night Navigators

As dusk falls, a little brown bat pokes its head from its day roost under the eaves of an old barn. It unfolds its wings and flaps them steadily, heading for a pond where mosquitoes swarm.

A bat on the hunt is a mysterious sight, if you can see it at all. On this night, like many nights, the little brown bat hunts in near-total darkness. Early bat scientists were baffled by bat navigation—in their experiments, even blindfolded bats could fly without crashing! How did the animals find their way around obstacles and catch insects when they couldn't see? It took almost 200 years for scientists to figure out that bats navigate using sound.

REMEMBER YOUR CODES
! This is important.
✓ I knew that.
X This is different from what I thought.
? I don't understand.

Sound Makes Waves

To make a sound, the bat vibrates vocal cords in its throat. Each vibration gives the air nearby a shove. That shove pushes those air molecules into the neighboring molecules, which then knock into the next bunch of molecules, and so on, as shown in Figure S13.1. Individual molecules only move a little as they knock back and forth, and each molecule ends up back where it started. But the energy keeps moving forward through the air. This creates a wave, or a disturbance that moves energy from one place to another.

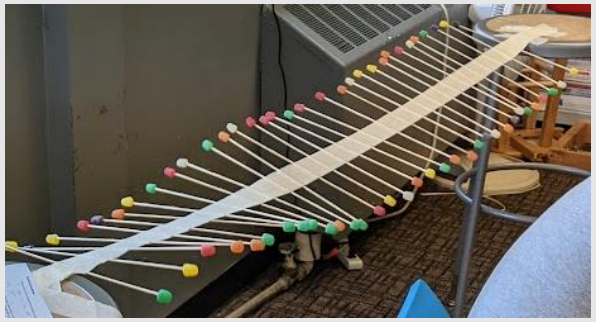
In sound waves, the molecules are knocked back and forth along the same line in which the energy is traveling. Waves in which the molecules and energy travel in the same plane are called longitudinal waves. But not all waves follow this pattern.

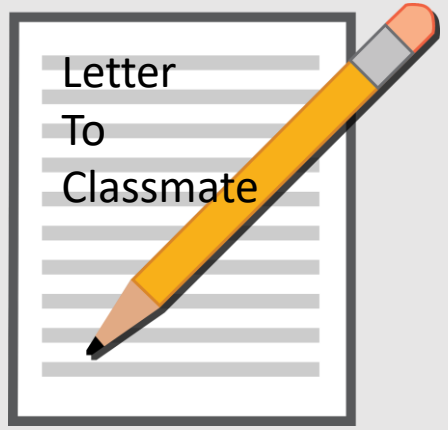
Figure S13.1. A Sound Wave Compresses Air

Part 3: Write about it

- Revisit the wave model. Use the article to make sure you understand the words wave, frequency, amplitude, and transverse wave.
- Write a letter to a friend who missed class today. Explain to your friend what these 4 words mean AND how you could see them illustrated in your wave machine. Feel free to include drawings or diagrams if they would be helpful!

Lesson Structure





Real Science

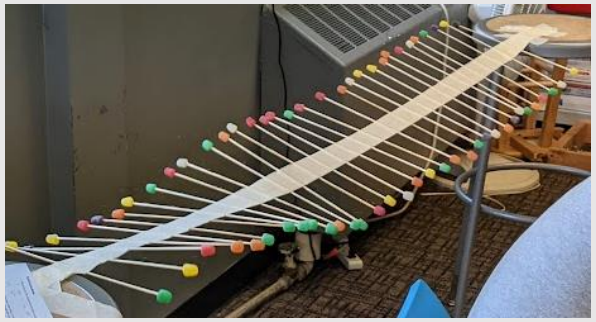
Analytical Reading

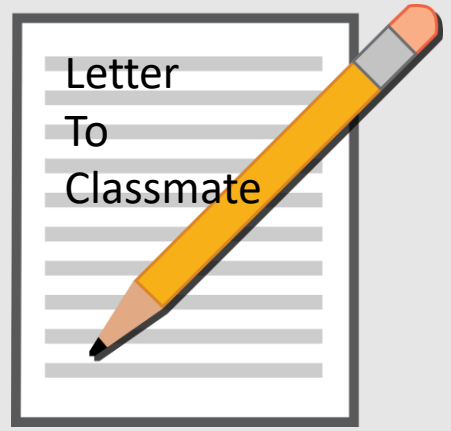
Academic Writing

More Complex Literacy Learning Cycle

Specific Reading Strategy

Specific Writing Strategy





Real Science

Analytical Reading

Academic Writing

Questions? Comments?

3. Digging Deeper on Reading: Three Impediments to Learning from Text

How do you know if you understand what you are reading?

What do you do if you realize you don’t understand?

The belief that reading is essentially a process of saying the words rather than actively constructing meaning from texts is widespread among many students. For instance, one of the students we interviewed looked surprised when he was asked to describe the topic discussed in a section of text he had just read.

"I don't know what it was about," he answered, with no sense of irony, ***"I was busy reading. I wasn't paying attention."***

(Schoenbach, et al.; Reading for Understanding)

3 Impediments to Learning from Text

Impediment 1:

Students do not expect what they are reading to make sense.

Response: start a conversation

- Talk about needing to “figure out” as a normal part of reading science.
- Encourage students to pay attention to what they are thinking as they read.
- Model the kind of thinking that successful readers use through Thinking Aloud

Thinking Aloud

Ms. Wheeler pulls another wild turn, this time to the left. Everyone in your seat flies right, and Football Fred slams into you. Whoa! It was awkward when Tiny Tiana was snuggling your shoulder, but with Football Fred, you feel like you've been hit by a boulder.

What caused this unintentional tackle? You guessed it—inertia! The more mass an object has, the greater its inertia. Football Fred has more mass than Tiny Tiana, so Football Fred also has more inertia. It is going to take an even greater outside force to get Fred to turn with the bus. And where is he getting that outside force? From your poor, bruised shoulder.

Somerset Draw with Durham Hands Notts the Title

After bowling the home side out for 320, Somerset were left needing 181 from 17 overs to guarantee the title. But, at 48-3, the chase was abandoned at Chester-le-Street and a draw agreed.

Fired-up Notts then took the three Lancashire wickets they required at Old Trafford to pick up a sixth bonus point and break Somerset hearts.

Eventually, Trego had Scott Rushworth caught behind and Benkenstein was caught at slip by skipper Marcus Trescothick off Charl Willoughby to set up the Somerset chase.

They went to the crease not knowing if a draw would be good enough to hold off Notts and immediately lost Kieswetter, promoted up the order, when he was bowled by Somerset old boy Blackwell.

3 Impediments to Learning from Text

Impediment 2:

Students lack background knowledge assumed by the text.

(US Fish and Wildlife)

Young California Condor

"Some people were afraid the condor would soon be gone."

X

"I would think the people would be afraid when the condor was THERE."

Image courtesy NSF

~~extinction~~

~~biodiversity~~

Background knowledge: non-science vocabulary

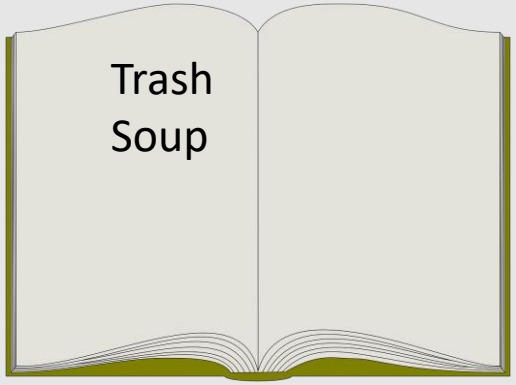
Adequate	Contradict
Tentative	Characteristic
Substance	Offspring
Deposit	Gradual

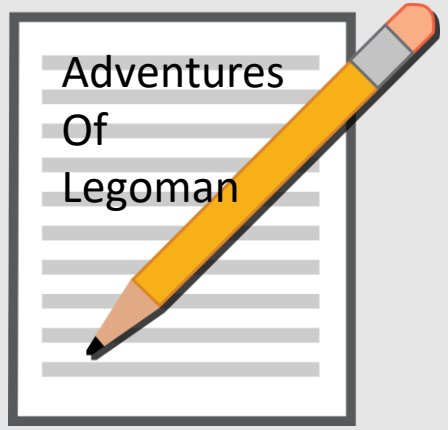
(All words used in academic writing, but not very often in speech)

Responses:

- Have students explore before reading!
- Read the text, looking for background they'll need.
- Listen, listen to what they say about the text.
- Consider reading groups or having students think aloud to each other.

Lesson Structure





Real Science

Analytical Reading

Academic Writing

Ferdie and Niddle gabbled on the plag, plag wert. “Pling,” Ferdie twaddled, “pling apie plee.” Niddle peedled and vang rue sot.

Comprehension Questions:

1. Where did Ferdie and Niddle gabble?
2. What did Ferdie twaddle?
3. What did Niddle do after he peedled?

*Critical Thinking:

4. Where else might Ferdie and Niddle gabble?

3 Impediments to Learning from Text

Impediment 3:

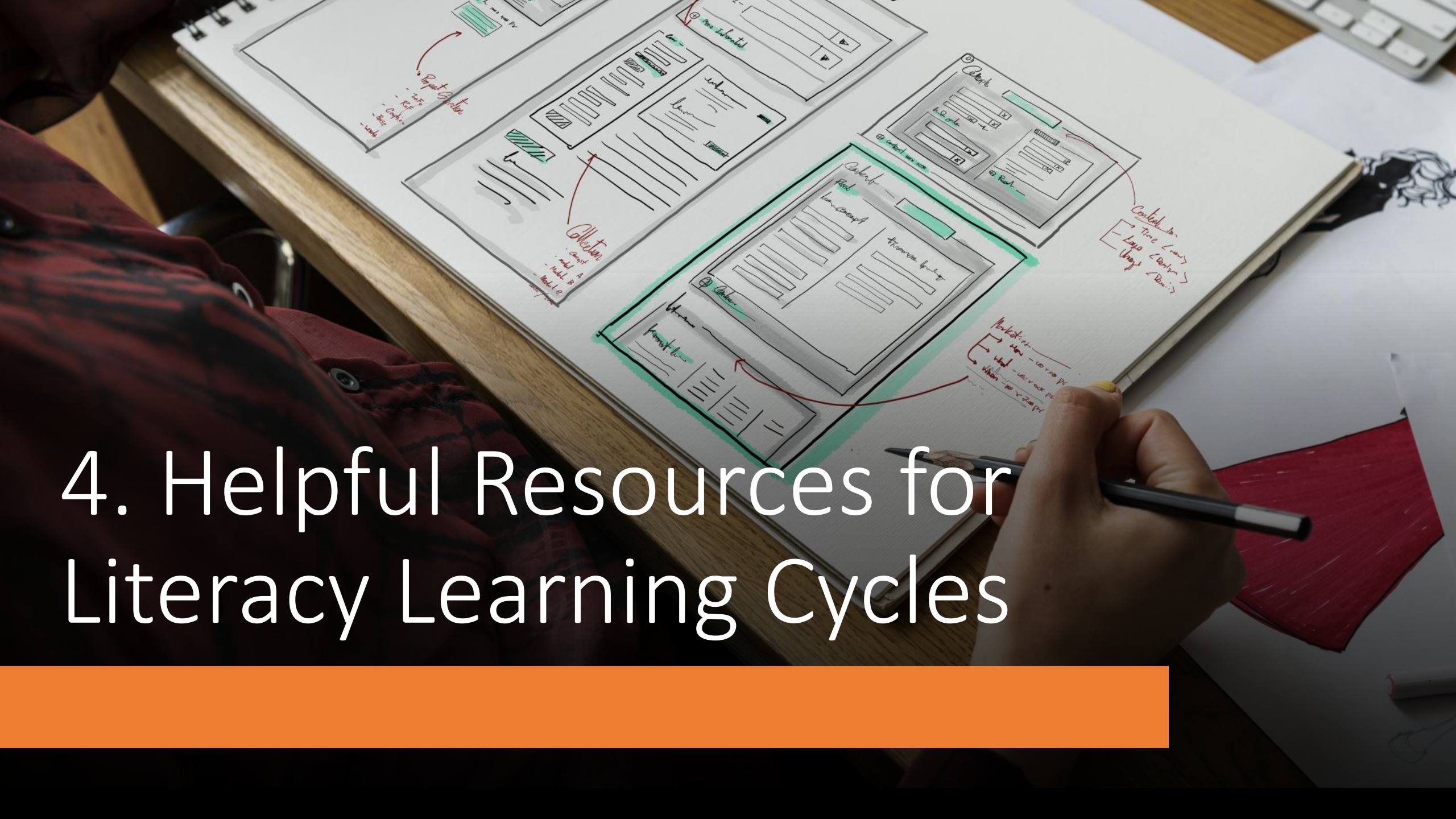
They don’t have to read to do their school tasks.

Response:

- Give them better tasks!

(That is, ask questions and give assignments that they cannot complete by just copying sentences.)

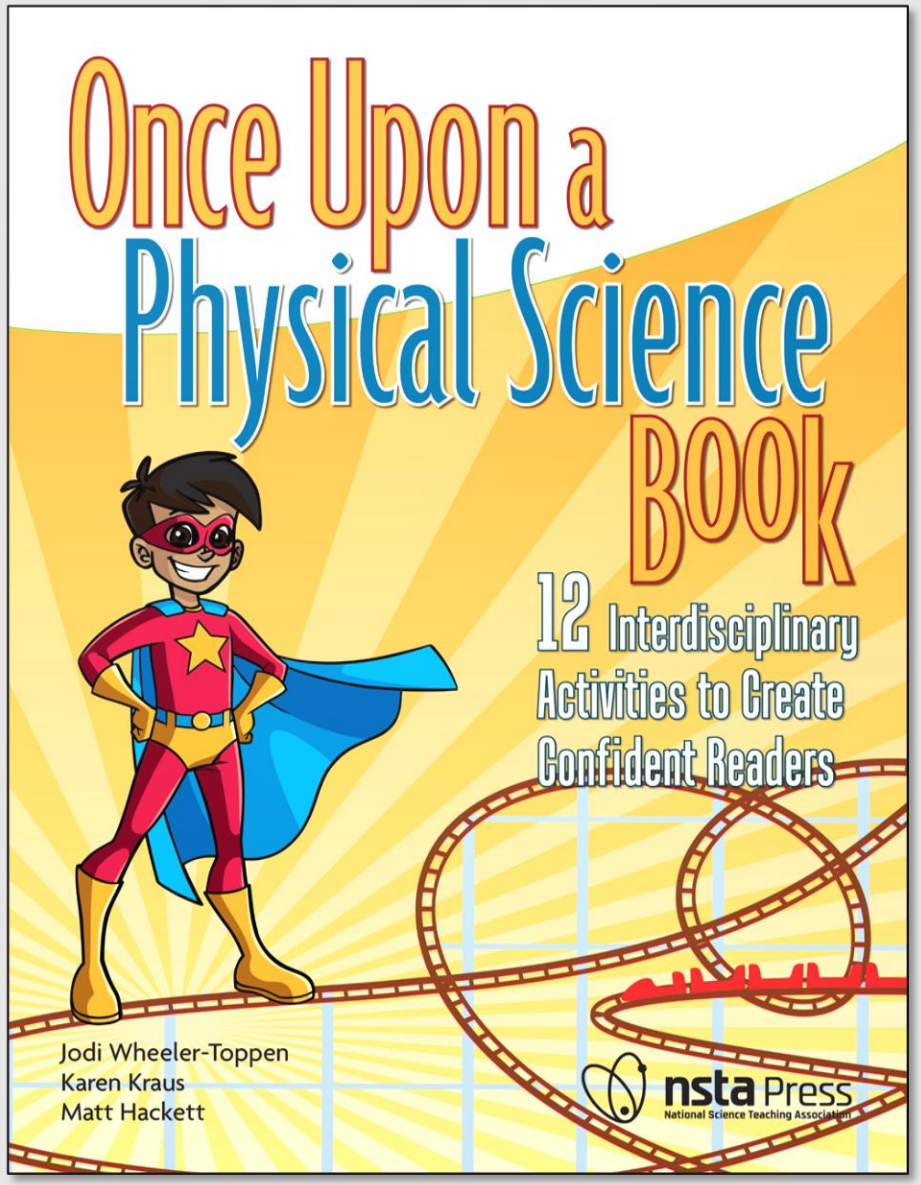
Questions? Comments?

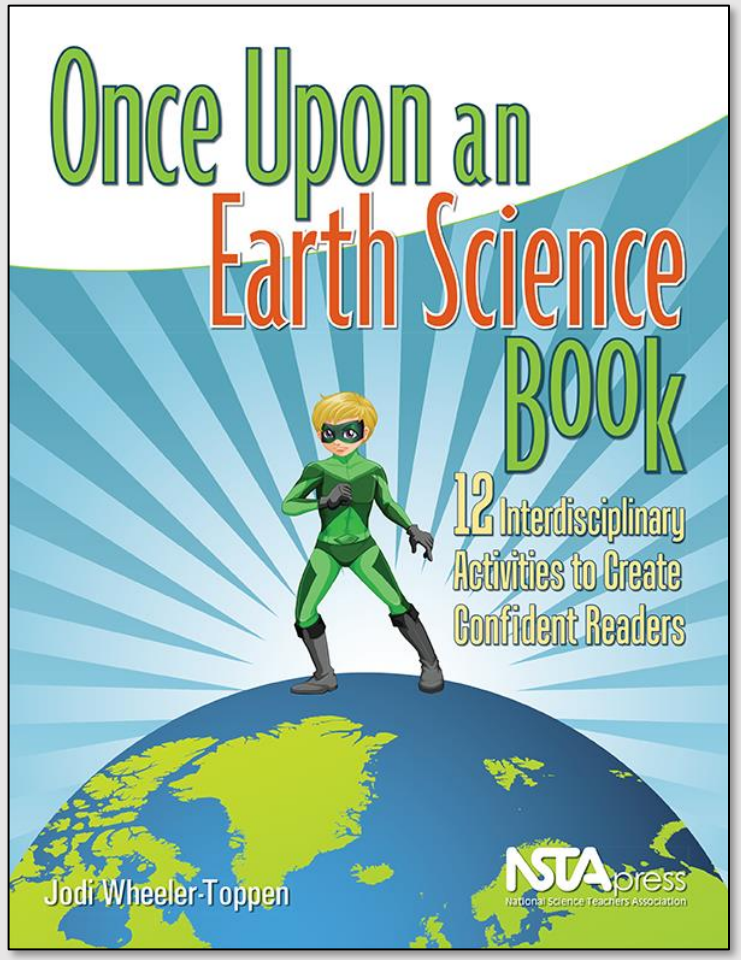


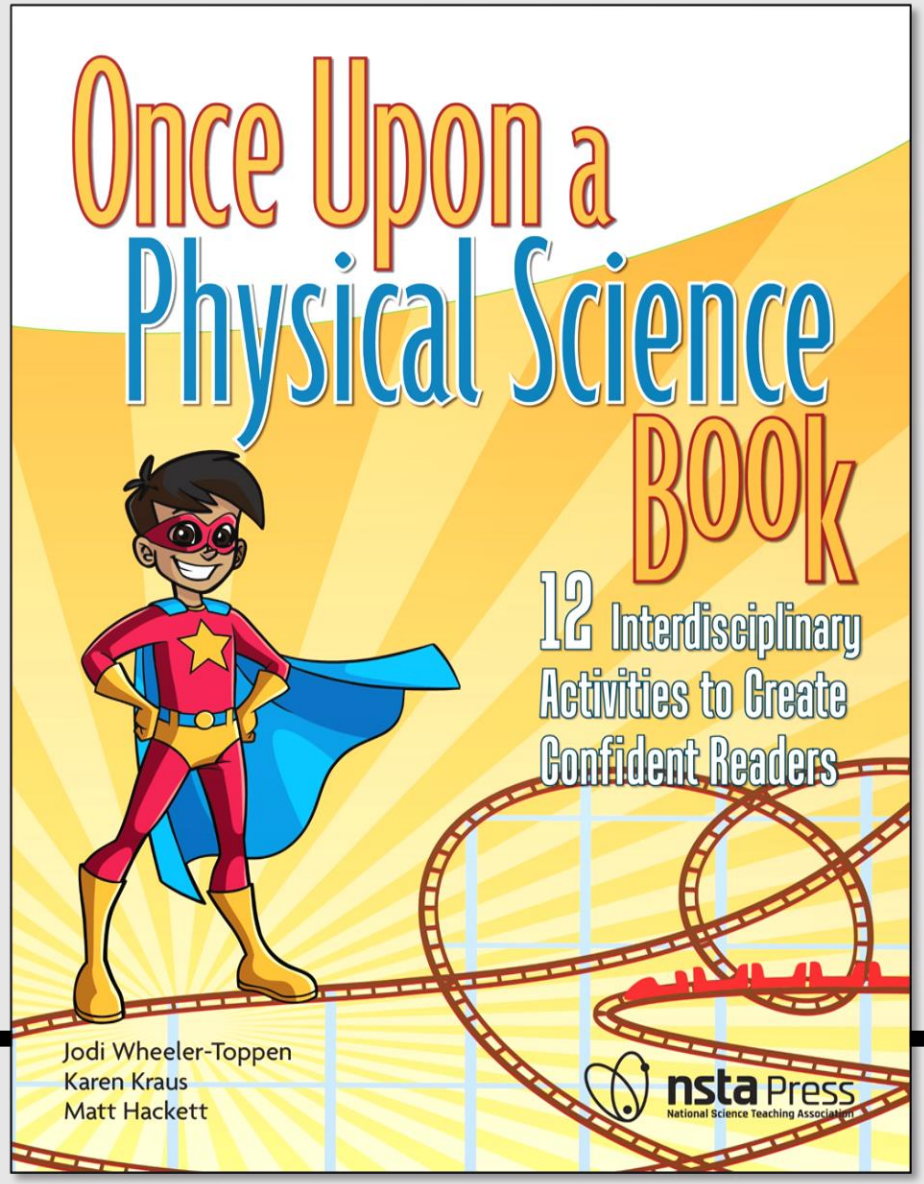
4. Helpful Resources for Literacy Learning Cycles

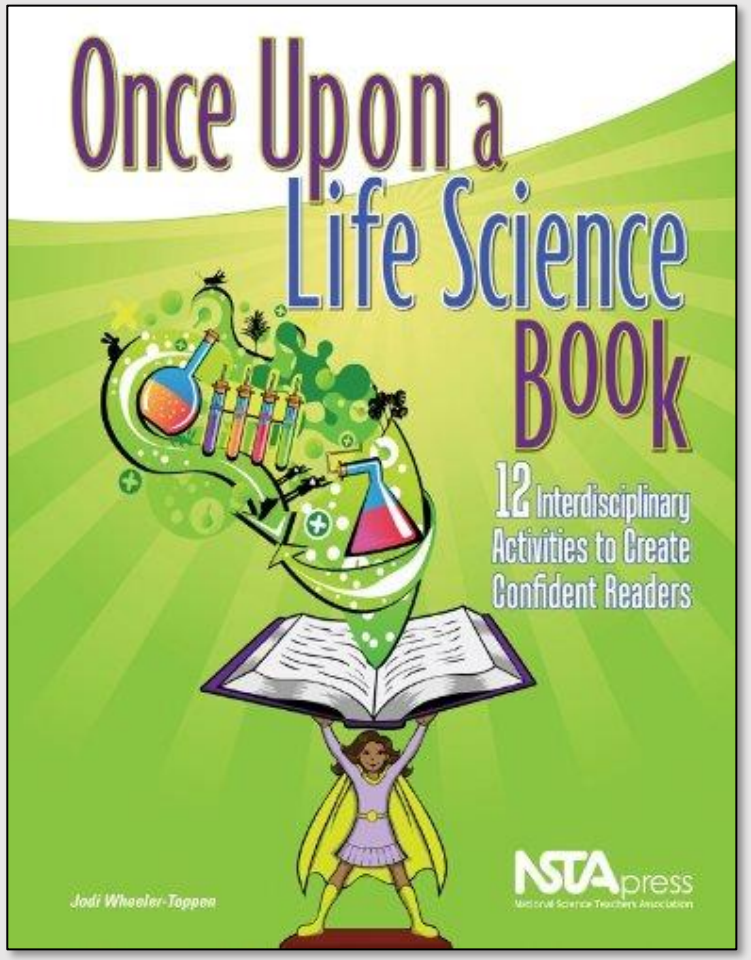
Each chapter includes:

- 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” activity




Once Upon an Earth Science Book
12 Interdisciplinary Activities to Create Confident Readers
Jodi Wheeler-Toppen
NSTA press
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 Activities to Create Confident Readers
Jodi Wheeler-Toppen
NSTA press

Related Resources for the Books

- https://onceuponasciencebook.com/for-educators/resources-for-teaching-online-with-the-once-upon-books/
- https://wheelertoppen.files.wordpress.com/2017/03/georgia-standards-of-excellence-correlations-life-science.pdf
- https://wheelertoppen.files.wordpress.com/2017/03/georgia-standards-of-excellence-correlations-earth-science.pdf

Georgia DOE Literacy Learning Cycles

- Kindergarten Day and Night
- First Grade Light
- Second Grade Shadows
- Third Grade Fossils
- Fourth Grade Ecosystems
- Fifth Grade Erosion
- 6th Grade Science Literacy Task: Tornadoes
- 7th Grade Science Literacy Task: Cells
- 8th Grade Science Literacy Task: Mixtures

Short Videos

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: For Teachers in Grades K-12
- 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

I do staff development on integrating literacy and science.

Send your “person in charge” to see me *Friday* from **2-3** in the NSTA Hub. (It’s drop-in.)

Or have them e-mail me at wheelertop@gmail.com

Read. Write. Science!

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