LIVE INTERACTIVE LEARNING @ YOUR DESKTOP

Moving Toward NGSS: Connecting Science to Common Core With Picture-Perfect Science Lessons

Web Seminar 2

Instructor: Emily Morgan

December 9, 2013
6:30 p.m. ET / 5:30 p.m. CT / 4:30 p.m. MT / 3:30 p.m. PT
Introducing the course instructor...

Emily Morgan
NSTA Press author
- *Picture-Perfect Science* series
- *Teaching Science Through Trade Books*
- *Next Time You See* children's book series
Moving Toward NGSS: Connecting Science to Common Core

with

Picture-Perfect Science Lessons

Web Seminar 2
Which picture books did you share?

Use the text box tool to type on screen.
How does the 5E model support the integration of NGSS and Common Core?
How familiar are you with the 5E Instructional Model?

Place an “x” on the chart to represent your familiarity.

0  1  2  3  4

Never heard of it  Could teach a class about it
BSCS 5E Model
Chapter 16: Fossils Tell of Long Ago
Draw a Dinosaur
Looks like it’ll be another F in class participation, Rex!

This is so unfair!
I'll never forget when my kindergarten teacher thumb-tacked my crayon drawing of a robin up on the classroom bulletin board. I'm sure I scuffed my penny loafers on the linoleum floor. I know that my cheeks burned with pride as she held my drawing in front of the class! No wonder that all these years later I am still drawing!

-Claire Ewart
FOSSIL

Claire Ewart
I found a stone that once was bone.
Thin bone, 
framing skin stretched tight, 
spread to warm in dawn's first light.
Wings extend as dawn gives way, gliding, flapping into day.
Strong bone,
skimming salty breeze,
scooping squid from teeming seas.
Fleet bone, fleeing jagged teeth of hungry jaws that snap beneath.
Screeching, beating,
wings repeating,
rhythms woven into bone.
Stretch for sky, reach for home.
Weary bone, 
wing tips grazing wave and foam, 
gliding toward an island home.
Gullet full as day is done,
salty prey to feed her young.
Then wrap wings close through primal night.
Stretch at dawn, again take flight.
Until, one day, 
old bone, 
tired bone, cannot rise, 
to slip again through amber skies.
Still bone,
silent bone, living days done.
But millions of days are yet to come.
Silt buries,
presses down,
until bone is embraced.
Minerals seep through the ground. Slowly bone is replaced.
Then wind follows rain, and time is erased, until . . .
I find a stone
that once was bone.
Questions on Page 226
When we find a fossil today it may seem like a stone, but it is actually the result of an amazing transformation that happens over millions of years.

During the Mesozoic era (248 million to 65 million years ago), dinosaurs thundered across the land, and enormous reptiles swam in the salty oceans. Reptiles called pterosaurs ruled the ancient skies. Similar to bats today, ancient pterosaurs had wings of skin that stretched between the bones of the arm and a very long fourth finger.

Few pieces of the pterosaur in this story, Ornithocheirus (Or-NITH-oh-KAI-rus), have been found. Yet these, and more complete skeletons of other pterosaurs, suggest how Ornithocheirus may have lived. Much as seafaring birds like pelicans or albatross do today, Ornithocheirus may have spent most of its life at sea—snatching prey from the water, racing away from predators, and choosing islands as safe places to nest.
When *Ornithocheirus* died, it sank into the fine silt at the bottom of the sea. The silt covered its body, protecting it from scavengers. Lack of oxygen at the bottom of the sea protected it from completely decomposing. Over time, these layers of sediment pressed down on the skeleton that remained. After thousands, then millions, of years, the surrounding sediment compressed into rock.

All this time Earth was changing. Climates changed. Continents shifted. Some animals evolved, but others couldn’t keep up. Twenty-five million years after *Ornithocheirus* died, dinosaurs and pterosaurs were extinct. Beneath the ground, minerals from the earth replaced part or all of *Ornithocheirus*’s bones, making what remained as hard as stone. *Ornithocheirus* had become a fossil.
For 90 million years, layers of the Earth folded, mountain ranges thrust upward. Seas receded. Heat, cold, wind, sun, ice, and rain wore away the ground, and finally the fossil of *Ornithocheirus* was exposed.

A fossil might reveal details of evolution or remind us how fragile life can be when environmental conditions change. Or perhaps from a fossil we might catch the scent of salty seas and feel the rush of brisk air, as strong bone skims ocean breeze.
OBSERVING FOSSILS
### Observing Real Fossils

<table>
<thead>
<tr>
<th>Ammonite</th>
<th>Trilobite</th>
<th>Brachiopod</th>
<th>Gastropod</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Ammonite" /></td>
<td><img src="image2" alt="Trilobite" /></td>
<td><img src="image3" alt="Brachiopod" /></td>
<td><img src="image4" alt="Gastropod" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Crinoid Stem</th>
<th>Cephalopod</th>
<th>Branch Coral</th>
<th>Fossil Clam</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Crinoid Stem" /></td>
<td><img src="image6" alt="Cephalopod" /></td>
<td><img src="image7" alt="Branch Coral" /></td>
<td><img src="image8" alt="Fossil Clam" /></td>
</tr>
</tbody>
</table>
Fossil Formation Cards

1. An animal is alive and swimming in a sea.
2. The animal dies and sinks to the bottom of the sea.
3. The soft parts of the animal rot away.
4. The animal's bones are left on the seafloor.
5. The skeleton of the animal is buried in the mud on the seafloor.
6. Over a very long time, more and more mud is piled over the animal.
7. Over a very long time, the animal's bones are slowly replaced with stone.
8. The animal becomes a fossil.
9. The fossil is discovered.
Card Sequencing
FOSSILS
TELL OF LONG AGO
BY ALIKI
Fossils Tell of Long Ago
Read-Aloud

Connecting to the Common Core
Reading: Informational Text
Integration of Knowledge and Ideas: 3.9, 4.9, 5.9
Key Ideas and Details: 3.3, 4.3, 5.3
Once upon a time a huge fish was swimming around when along came a smaller fish. The big fish was so hungry it swallowed the other fish whole. The big fish died and sank to the bottom of the sea.
This happened ninety million years ago.
How do we know?
We know because the fish turned to stone.
The fish became a fossil.
A plant or animal that has turned to stone is called a fossil.
Scientists can tell how old stones are. They could tell how old the fish fossil was.
How did the fish become a fossil?
Most animals and plants do not become fossils when they die. Some rot.
Others dry up, crumble, and blow away.
No trace of them is left.
This could have happened to the big fish.
We would never know it had lived.
Instead, the fish became a fossil.
This is how it happened.
When the big fish died, it sank into the mud at the bottom of the sea. Slowly, the soft parts of the fish rotted away. Only its hard bones were left. The bones of the fish it had eaten were left, too. The skeleton of the fish lay buried and protected deep in the mud.
Thousands of years went by.
More layers of mud covered the fish.
Tons and tons of mud piled up.
After a long time, the surface of the earth changed.
The sea where the fish was buried dried out.
The weight of the layers of mud pressed down. Slowly, the mud turned to rock. As that happened, ground water seeped through the changing layers of mud. Minerals were dissolved in the water. The water seeped into all the tiny holes in the fish bones. The minerals in the water were left behind in the fish bones. After a very long time the bones turned to stone. The fish was a fossil.
How does this book’s information compare with what we read in our last book, *Fossil*? (In both stories the animal died underwater, was buried in the sand, and was found millions of years later.)
Fossils tell us there once were forests where now there are deserts.

200 Million Years Ago

That's the Painted Desert and the Petrified Forest! I've been there!

Fossils of these plants and animals were found in that desert!

"Petrified" means "turned to stone."

Wow! A fossil forest!
Fossils tell us there once were seas where now there are mountains.

These fossils of sea creatures were found on mountains.

The earth has changed a lot since then.
Many lands that are cold today were once warm. We find fossils of tropical plants in very cold places.
Fossils tell us about strange creatures that lived on earth long ago. No such creatures are alive today. They have all died out. We say they are extinct.
Every time someone finds a fossil, we learn more about life on earth long ago. Someday you may find a fossil—one that is millions and millions of years old. You may discover something no one knows today.

I wonder what people will look like a million years from now.

Find anything yet?
Xiphactinus
Card Sequencing
Fossil Game
Fossil Fortune Teller

Template 1

Fossilized!
STAY STANDING.

Washed away by the current.
SIT DOWN.

Dried up.
SIT DOWN.

Washed away by the current.
SIT DOWN.

Swallowed by a fish.
SIT DOWN.

Worn away by wind and rain.
SIT DOWN.

Eaten by a dinosaur.
SIT DOWN.

Rotted away.
SIT DOWN.

Cut off at the dotted line to make a square.
The Fossil Game Board

A  B
C  D

How to Play “The Fossil Game”

1. Have the students stand up and spread out in the classroom holding their assembled fortune tellers.
2. Record the number of students in the class in the “Number of Organisms” column.
3. Hold the die about an inch above the star on the game board and drop it.
4. Call out the number that lands face up, and instruct the students to open and close their fortune tellers that many times.
5. Call out the letter that the die landed on. Have the students open that panel under the corresponding letter to discover their fate. If they became a fossil they should remain standing, otherwise they should sit down.
6. Count the number of students who are standing and record that number in the “Number of Fossils Formed” column of the data table.
7. Have everyone stand for the next round. The game ends after five rounds.
## The Fossil Game Data Table

<table>
<thead>
<tr>
<th>Round</th>
<th>Number of Organisms</th>
<th>Number of Fossils Formed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Number of Organisms:**

**Total Number of Fossils Formed:**
According to *A Framework for K–12 Science Education*, children in grades 3–5 should learn that fossils are used by people today to learn about both the types of living things that lived long ago and the nature of their environments. *Paleontology* refers to the study of fossils and what fossils can tell us about the history of Earth. The American Museum of Natural History website identifies four big ideas of paleontology on the “PaleontOlogy: The Big Dig” section for kids (www.amnh.org/explore/ology/paleontology): (1) fossils tell stories about Earth’s history, (2) fossils can’t tell us everything, (3) fossils are really rare, and (4) the fossil record is like a big jigsaw puzzle, with most of the pieces missing. It is not important that students memorize the names of and specific details about different dinosaurs or prehistoric animals; rather, the focus should be on these “big ideas.”

The term *fossil* refers to physical evidence of former life from prehistoric time. This prehistoric evidence includes fossilized remains of living organisms, impressions and molds of their physical form, and marks or traces created in sediment by their activities. Fossils can be divided into two broad categories: fossilized body parts (bones, teeth, skin, and so on) and fossilized traces (footprints, nests, dung, and so on). There are a variety of ways that living things can become fossilized. This lesson focuses on the process of *permineralization*, in which minerals replace the actual organic remains of the organism.

One objective for this lesson is for students to understand that it is very uncommon for living things to become fossilized. When most organisms die, they decay without a trace after natural processes recycle their soft tissues and even their hard parts such as bone and shell. For a plant or animal to become fossilized, the conditions at the time of death must be just right. If a plant or animal is not buried soon after death, fossilization often becomes impossible because of scavengers, algae, bacteria, and weather conditions such as rain, wind, water erosion, and sun exposure. This means that very few plants and animals actually become fossilized. Some scientists estimate that fewer than 2% of plant or animal species that lived on Earth have ever become fossilized.

Fossils teach us not only about the plants and animals of the past but also about the Earth’s topography and climate change. Paleontologists may find tropical plant fossils in modern-day deserts or fossils of sea creatures in a modern-day farmland. These discoveries give us clues about how those places have changed over time in climate and topography. Fossils help us piece together the long history of Earth and its inhabitants.
I Found a Fossil

Scoring Rubric

Write and illustrate a story about finding a fossil. Include the criteria listed below on your poster.

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Cover:</td>
</tr>
<tr>
<td>3</td>
<td>Your name and a detailed drawing of the fossil</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Page 1:</td>
</tr>
<tr>
<td></td>
<td>The name of the fossil in the sentence (&quot;I found a stone that once was __________.&quot;) and an illustration of you discovering the fossil</td>
</tr>
<tr>
<td></td>
<td>Page 2:</td>
</tr>
<tr>
<td></td>
<td>A description and illustration of what the animal looked like when it was alive</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pages 3 &amp; 4:</td>
</tr>
<tr>
<td></td>
<td>Descriptions and illustrations of the animal surviving in its habitat (What did its environment look like at the time? How did it move, get food, escape from predators? and so on)</td>
</tr>
<tr>
<td></td>
<td>Page 5:</td>
</tr>
<tr>
<td></td>
<td>A description and illustration of how the animal became fossilized</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Page 6:</td>
</tr>
<tr>
<td></td>
<td>A description and illustration of how the fossil was uncovered and discovered by you</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Points/24</td>
</tr>
</tbody>
</table>

National Science Teachers Association
ENGAGE

Which activities were part of the engage phase of this lesson?

Use the text box tool to type on screen.
EXPLORE

Which activities were part of the explore phase of this lesson?

Use the text box tool to type on screen.
EXPLAIN

Which activities were part of the explain phase of this lesson?

Use the text box tool to type on screen.
ELABORATE
Which activities were part of the elaborate phase of this lesson?

Use the text box tool to type on screen.
EVALUATE

Which activities were part of the evaluate phase of this lesson?

Use the text box tool to type on screen.
Time Needed

This lesson will take several class periods. Suggested scheduling is as follows:

**Day 1:** Engage with Draw a Dinosaur and *Fossil* Read-Aloud

**Day 2:** Explore with Observing Real Fossils and card sequencing and Explain with *Fossils Tell of Long Ago* Read-Aloud

**Day 3:** Elaborate with The Fossil Game

**Day 4:** Evaluate with *Fossil* Rereading and I Found a Fossil Writing Activity
Suggested Grade Levels: 3–5

LESSON OBJECTIVES Connecting to the Framework

LIFE SCIENCES

Core Idea LS4: Biological Evolution: Unity and Diversity
LS4.A: Evidence of Common Ancestry and Diversity

By the end of grade 5: Fossils provide evidence about the types of organisms (both visible and microscopic) that lived long ago and also about the nature of their environments. Fossils can be compared with one another and to living organisms according to their similarities and differences.
LS4.A: Evidence of Common Ancestry and Diversity

- Some kinds of plants and animals that once lived on Earth are no longer found anywhere. *(Note: moved from K-2) (3-LS4-1)*
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. *(3-LS4-1)*
Question break

- What questions do you have?
- What are your thoughts about what we’ve covered so far?
BSCS 5E Model

**Time Needed**

This lesson will take about a week. Suggested scheduling is as follows:

**Day 1:** Engage with *The Boy Who Harnessed the Wind* Read-Aloud and What’s in William’s Windmill? Preassessment

**Day 2:** Explore with Dynamo Torch, Dynamo Challenge, and Inside the Dynamo

**Day 3:** Explain with How Is the Dynamo Torch Like William’s Windmill? T-chart and close reading of “Energy Gets Things Done!” article

**Day 4:** Explain with *Wind Energy: Blown Away!* Read-Aloud and with What’s in William’s Windmill? Postassessment, Elaborate with Energy Resources

**Day 5:** Evaluate with Energy Resources Posters
The 5Es and NGSS
USE AN INTEGRATED INSTRUCTIONAL SEQUENCE SUCH AS THE BSCS 5E INSTRUCTIONAL MODEL.

Use an integrated instructional sequence as the basis for a curriculum unit. While lessons serve as daily activities, design the sequence of lessons using a variety of experiences (e.g., web searches, group investigations, reading, discussion, computer simulations, videos, direct instruction) that contribute to the learning outcomes described in the performance expectations.
FIGURE 4.3. THE BSCS 5E INSTRUCTIONAL MODEL

Engage

The engage lessons initiate the instructional sequence. An engaging activity should (1) activate prior knowledge and make connections between the students’ past and present learning experiences, and (2) anticipate activities and focus students’ thinking on the topics and learning outcomes in the forthcoming lessons. The learner should become mentally engaged with the science ideas, concepts, and practices of the instructional unit.

Exploration

The exploration should provide students with a common base of experiences within which they identify and begin developing science ideas, concepts, and practices. Students actively explore the contextual situation through investigations, reading, web searches, and discourse with peers.

Explanation

These lessons develop an explanation for the concepts and practices students have been exploring. The students verbalize their conceptual understanding and demonstrate their scientific and engineering practices. Teachers introduce formal labels, definitions, and explanations for concepts, practices, skills, or abilities.

Elaboration

The elaboration lessons extend students’ conceptual understanding through opportunities to apply knowledge, skills, and abilities. Through new experiences, the learners transfer what they have learned and develop broader and deeper understanding of concepts about the contextual situation and refine their skills and abilities.

Evaluation

This segment of the instructional sequence is based on the performance expectations and emphasizes students assessing their ideas, concepts, and practices. The evaluation also includes embedded assessments that provide feedback about the degree to which students have attained the competencies described in the performance expectations.
Owl Pellets to “Mystery Pellets”
Poll Question: Have you dissected owl pellets with students?

- Yes
- No
Chapter 10: Mystery Pellets
| What do you **OBSERVE** about the object? (Don’t forget to measure.) | What do you **WONDER** about the object? | What did you **LEARN** about the object? |
W_ite Ow_l, _Barn Ow_l

Nicola Davies illustrated by Michael Foreman

B_utternut H_ollow P_ond

by Brian J. Heinz
Illustrated by Bob Marstall
Butternut Hollow Pond

When one animal eats another living thing, they both become part of a food chain. A **food chain** is the path that energy takes as one organism eats another. There are some simple food chains in nature. But usually two or more food chains overlap and link, forming a food web. A **food web** is made of many food chains put together. All food webs include plants. Plants are **producers** and can make their own food. They get their energy from the Sun. Animals are **consumers**. They cannot make their own food so they must consume (eat) plants or other animals. The four main types of consumers are **herbivores** (plant eaters), **carnivores** (meat eaters), **omnivores** (plant and meat eaters), and **decomposers**. **Decomposers** are consumers that break down the tissues of dead organisms. They feed on everything that dies in a food web. Some examples of decomposers are bacteria and fungi (not shown on food web below).
"LINKING INQUIRY & CONTENT"

Regional Science Conference

ZOO-NIQUE
science conference
Register Here!
"LINKING INQUIRY & CONTENT"

Videos
Choose a category below

- Matter & Energy
- Living Organisms
- Force & Motion
The 5Es Teacher

Pages 32-33
On a piece of paper, create a t-chart and record the activities of the teacher and the students that demonstrate the 5Es model.

<table>
<thead>
<tr>
<th>5 Es Teacher</th>
<th>5 Es Student</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Picture-Perfect Science Lessons
Chapter 22: Batteries Included
Lesson Video
Evidence of the 5Es Teacher

Use the text box tool to type on screen.
Evidence of the 5Es Student

Use the text box tool to type on screen.
Name: ____________________________

Energy Ball

Before
Draw a picture of what you think is inside the energy ball.
Be sure to label your drawing.

After
Draw a picture of what you think is inside the energy ball.
Be sure to label your drawing.

How have your ideas changed? ____________________________________________
______________________________________________________________________
______________________________________________________________________
Exploring with a battery, bulb, and wires
Electrical Circuits

Directions
1. Cut out the cards in the boxes below.
2. Read the close paragraph and place the cards where you think they belong on the blanks.
3. Listen carefully while your teacher reads Electrical Circuits.
4. After reading, move the cards if necessary and glue or tape them on the page.

- chemical
- open circuits
- insulators
- closed circuits
- switch
- conductors
- battery
- circuit

A ________________ is the pathway along which current electricity flows.

Metals are good ________________ because electricity can easily flow through them. Plastic and rubber are good ________________ because they don’t conduct electricity. In ________________, conductors connect all the parts of the circuit. In ________________, there is an opening that prevents electricity from moving in a current. A circuit uses a ________________ to open and close it. A ________________ stores ________________ energy and changes it into electrical energy.
Energy Ball

Before
Draw a picture of what you think is inside the energy ball.
Be sure to label your drawing.

After
Draw a picture of what you think is inside the energy ball.
Be sure to label your drawing.

How have your ideas changed?
THE INSIDE OF THE ENERGY BALL
TOY TAKE-APART
Dear Parents,

We are learning about electrical circuits in class. We will do an activity called Toy Take-Apart, during which the students will take apart simple battery-operated children’s toys. If you have any toys that you can donate for this project, it would be greatly appreciated. The toys will be disassembled and may not be usable after the project, so please send only toys that your family does not want anymore.

Please send any old, battery-operated toys in by _________________.

If you are not able to send any toys, that’s okay. Toys will be provided for those who do not bring them from home.

PLEASE MAKE SURE THE TOYS ARE FREE OF BATTERY CORROSION.

Thank you,
Toy Take-Apart Checkpoint Lab

Follow the directions below. If your team is working, put the green cup on top. If you have a question, put the red cup on top. If you are finished with a part and you are ready for a check from your teacher, put the red cup on top.

Part A Describe Your Toy

1. Name of toy: ____________________________

2. Explain how to play with the toy and what it does: ____________________________

3. Open the battery compartment. How many batteries does your toy require? _______ 

4. What size batteries does your toy require? ____________________________

5. Look closely at where the batteries are held in the toy. Do you see + or - signs in the battery compartment? _______ If so, why do you think they are there?

6. Draw and label what you think the toy looks like inside.

Checkpoint A □
Toy Take-Apart
Checkpoint Lab cont.

Part B Take It Apart

**SAFETY**
Wear safety goggles or glasses. Sharp objects, including metal and plastic objects, can cut skin. Be sure to use the screwdriver carefully, as demonstrated by your teacher.

1. Unscrew all of the screws that are holding the toy together and place them in a baggie.
2. Open the toy very carefully so that you do not disconnect any of the wires inside.
3. Using sticky notes, label the following parts of your toy:
   a. Battery
   b. Wires
   c. Switch
   d. Speaker/buzzer/bulb/etc.
4. Draw and label a picture of the inside of your toy.
Part C How Does It Work?

1. Explain how your toy works. In other words, what has to happen for the toy to make sound or light or to move? What is the path of the electricity inside the toy? Use the following words in your explanation: battery, conductor, insulator, open circuit, closed circuit, switch.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Be prepared to display your labeled toy and your drawing and explain how the toy works to other students.

Checkpoint C □
Batteries and Bulbs Quiz

1. Circle all of the setups below in which the bulb will light.
   a.  
   b.  
   c.  
   d.  
   e.  
   f.  

2. Katie and David each put one finger on one of the metal parts of an energy ball. In which two pictures below would the energy ball light up and buzz?
   a.  
   b.  
   c.  

3. Explain why many of the electrical wires in your home are made of copper.

4. Explain why lamp cords are coated with plastic.

5. One group of students wants to add another battery to a circuit to make the bulb brighter. They add a battery, but the bulb does not light. See their setup below. Explain why the bulb doesn’t light.

6. Kevin and Juanita build the complete circuit below to light a bulb. They use a metal paper clip as a switch.

   After building the circuit, they close the switch, but the bulb does not light. Identify two possible reasons why the bulb does not light. For each possible reason, describe a way the students could test whether the suggested reason is the cause of the bulb not lighting.
NGSS

Disciplinary Core Ideas

PS3.A: Definitions of Energy
- The faster a given object is moving, the more energy it possesses. (4-PS3-1)
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2),(4-PS3-3)

PS3.B: Conservation of Energy and Energy Transfer
- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2),(4-PS3-3)
- Light also transfers energy from place to place. (4-PS3-2)
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4)

PS3.C: Relationship Between Energy and Forces
- When objects collide, the contact forces transfer energy so as to change the objects’ motions. (4-PS3-3)

PS3.D: Energy in Chemical Processes and Everyday Life
- The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)

ETS1.A: Defining Engineering Problems
- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (secondary to 4-PS3-4)
Before Our Next Session...

- Option 1: Try out a Picture-Perfect Science lesson in the classroom (from *Even More Picture-Perfect Science* or any of the books) OR in a lesson you already have planned, flip the order of explore and explain so that students have the opportunity to explore a concept before vocabulary and explanations are given.

- Option 2: Choose from a list of the videos from sciencemattersonline.com, identify each phase of the 5Es in that lesson, and summarize the role of the teacher and the role of the students in that lesson.
More 5Es Picture-Perfect Lessons from www.sciencemattersonline.com

- Be a Friend to Trees
- The Chemical Change Cafe
- Loco Beans
- Sunshine on My Shoulders
- Science Measures Up
- Over in the Ocean
- Oil Spill Clean Up
- How Many Seeds in a Pumpkin?
- Hear Your Heart
- Rice is Life
Thanks to the course instructor...

Emily Morgan
NSTA Press author
• *Picture-Perfect Science* series
• *Teaching Science Through Trade Books*
• *Next Time You See* children's book series
National Science Teachers Association

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