CONNECTING SCIENCE AND LITERACY

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Session Overview and Goals

- A brief review of the research associated with integrating reading and science.

- Presentation of selected children’s literature that can be utilized to teach both scientific practices and literacy skills will be shared. Recommendations for finding resources.

- Practical examples that engage participants in activities that allow them to internalize the process and return to their classroom ready to integrate science and children’s literature.
Literate and Scientifically Literate

- The standards reflect a contemporary view of literacy that is broader and more demanding than traditional definitions. Literacy today includes the capacity to accomplish a wide range of reading, writing, speaking, and other language tasks associated with everyday life.

  English Language Arts (1996, IRA/NCTE)

- In order to exist in the 21st century, students will need to be scientifically literate. This means they will need to “possess a set of skills that marries knowledge of science concepts, facts, and processes with the ability to use language to articulate and communicate about ideas.”

  Their, 2002, p. 1
As far back as 1976, the Council for Basic Education has reported that “there is impressive evidence that hands-on science increases achievement in reading and math in early grades.”

In 1977, a study showed that “children having science experiences (hands-on, activity oriented) scored significantly better on reading readiness....better on listening, vocabulary, matching, alphabet, and numbers” when compared with students who had a science-reading, teacher telling approach. (Barufaldi and Swift, 1977)
Benefits of Trade Book Integration

- Real life connections to narrative based text makes the material more interesting (Rice and Rainsford, 1996; Casteel and Isom, 1994; Stifler, 1992; Crook and Lehman, 1990)

- Results in higher levels of discussion of science concepts (Leal, 1992, 1993)

- Assists students in learning science concepts (Kralina, 1993; Fuhler, 1991)

- Increases interest level, improves reading skills, allows for individuality (Tunnel and Jacobs, 1989; Homes and Ammon, 1985)
Active experience with science helps language and logic development regardless of their socioeconomic status.

Selected science activities accelerate reading readiness in young children.

Science activities provide a strong framework for converting experience into language.

Reading skill development stems from language and logic development which comes after concepts are formed from repeated encounters.

Wellman, in What Research Says to the Science Teacher, 1978
Impacts on Learning

- Results indicate that information is retained longer when tradebooks are used (Maria and June, 1993)

- Tradebooks are less intimidating for students with low reading abilities (Castell and Isom, 1994; Carlile, 1992; Stifler, 1992; Crook and Lehman, 1990; Lyttle, 1992)

- Material in tradebooks allows for more depth of coverage rather than a general overview (Crook and Lehman, 1990)

- Aids the classroom teacher in designing hands-on activities based on the concepts (Pond and Hoch, 1992)
Research about Brain-based Learning

The reading process parallels the process of scientific inquiry – both areas require skills in questioning and setting a purpose, analyzing and drawing conclusions, and communicating results.

Yore, Craig, and Maguire (1995)

CC & NGSS Tie In: Asking questions; analyzing data; Constructing explanations; and obtaining, evaluating and communicating information.
Therefore......

- Science gives **meaning and purpose** to literacy activities by providing a rich field of content that students are naturally curious about.

- One literacy builds on the other literacy since **language becomes the avenue through which science is communicated**.

- Science instruction **improves reading skills**.

- **Both disciplines profit** when science and reading are combined.
Role of Knowledge in Meaningful Learning

- Prior knowledge is a major determinant of future learning
- In-depth understanding involves conceptually organizing knowledge which, in turn makes it accessible for later use.
- To be of value, curriculum must build cumulative knowledge used in future learning
Cognitive Research and the Importance of Order

- Providing students with rich experiences first, followed by asking them to read, write, and speak about them is key to integrating science and reading (and having students learn).
- Too often the process is reversed with experiential learning coming at the end or not at all.
- Hands-on/minds-on science can bridge the gap between experience and learning as well as between subject areas!
## Importance of Cognitive Order

<table>
<thead>
<tr>
<th>Experience First</th>
<th>Creation of Models</th>
<th>Symbols</th>
</tr>
</thead>
</table>
| • Experience needs to occur first.  
  • Engagement in investigations  
  • Exploration  
  • Activation of prior knowledge and connect new knowledge | • Process and reflect on their experiences.  
  • Aides in the construction of knowledge and the development of mental models and pictures. | • Finally, discuss concepts from their experiences.  
  • Learn vocabulary in context.  
  • They develop a symbolic representation of their experiences and can communicate that to others. |
An Example

- The procedure is actually quite simple. First, arrange things into different groups. Of course, one pile may be sufficient depending on how much there is to do. If you have to go somewhere else due to lack of facilities, that is the next step, otherwise you are pretty well set.

- What process is occurring above?
It is important not to overdo things. That is, it is better to do too few things at once than too many. In the short run this may not seem important but complications can easily arise. A mistake can be expensive as well. At first, the whole procedure will seem complicated. Soon, however, it will become just another facet of life. It is difficult to foresee any end to the necessity of this task in the immediate future, but then one never can tell.
After the procedure is completed, one arranges the materials into different groups again. Then they can be put into their appropriate places. Eventually, they will be used once more and the whole cycle will then have to be repeated. However, that is part of life.

So what are we doing?
## Observation/Inference Chart

<table>
<thead>
<tr>
<th>What are my observations?</th>
<th>What do I think about this?</th>
</tr>
</thead>
</table>

Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

### What did I learn?

- [Nature](#)
- [Woods & Forests](#)
- [I Took a Walk](#)
- [Dr. Xargle's Book of Earthlets](#)
Using Trade Books for Making Observations and Drawing Inferences

- Sample activity
- Incorporates science process skills and reading skills
- Simple materials
- Engages students
Wonderful Water

- K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.*

http://water.usgs.gov/edu/sq3.html
# My Own Impact

## Personal Water Use Chart

<table>
<thead>
<tr>
<th>Activity</th>
<th>Sun</th>
<th>Mon</th>
<th>Tues</th>
<th>Wed</th>
<th>Thurs</th>
<th>Fri</th>
<th>Sat</th>
<th>Total number of times</th>
<th>Estimated amount of water used (gallons)</th>
<th>Total weekly water use (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washing face or hands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taking a shower (standard shower head)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taking a shower (low-flow shower head)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taking a bath</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brushing teeth (water running)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brushing teeth (water turned off)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flushing the toilet (standard flow toilet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flushing the toilet (low-flow toilet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinking water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooking a meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washing dishes by hand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Running a dishwasher load</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washing a load of laundry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watering lawn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washing car</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Total Weekly Water Use (in gallons) ➔

Log from: [Teach Engineering Resources for K-12](https://www.teachengineering.org/education/teaching-resources)
I statements.

- I statements help students make specific decisions about their impact on the environment.

- Simply create a bulletin board with individual student water droplets that include the statement....
  - I can reduce my water usage by.......  
  - And allow the students to complete the statement.

K-ESS3.C: Human Impacts on Earth Systems - Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.

K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
Where is Our Water?

2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.
How much water?

- Conduct Demonstration or Allow Students to Conduct Activity
- Discuss how much water is available.
- Create graphic that represents distribution
- Identify local sources of water and types

### Earth’s Total Water Supply
- 972 mL Ocean (saltwater)
- 28 mL Freshwater
- 1,000 mL Total Water on Earth

### Earth’s Total Freshwater Supply
- 23.0 mL Icecaps and glaciers
- 4.0 mL Ground water
- 0.7 mL surface water
- 0.3 mL water in air and soil
- 28.0 mL Total freshwater on Earth

1 liter = 1,000 mL

5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
What is the water cycle?

- Water Cycle Journey Game
- Stations
- Roll the Die at each station to determine where you go next
- Record journey
- Write story or Illustrate Cycle
Quick Foldable for Learning

The Water Cycle

- Evaporation
- Condensation
- Precipitation
- Infiltration
- Surface Runoff
- Lakes
- Groundwater
- Ocean water
- Snow/ice
- Transpiration

Quick Facts:
- Water constitutes 60% of our water vapor
- Ocean water vapor
CHEESE

Market Day is cheese day as well.
We get our cheese from Heather and her daughter, Katelyn. They let us taste samples of the many cheeses that they make.
How Did That Get In My Lunch Box? The Story of Food

First page: How Did That Get In My Lunch Box? The Story of Food by Chris Butterworth

Second page: How did your tomatoes get in your lunchbox? Page 1:

Day by day, the plants sucked up water and the tomatoes swelled from green to orange to red.

Page 2:

When bunches of red, sun-ripened tomatoes dangled from the branches, the grower picked them.

Page 3:

1. Sort them...
2. Pack them...
3. Send them to the store.

Page 4:

POP one in your mouth and squish the sweet sour juice out!
<table>
<thead>
<tr>
<th>Field</th>
<th>Processed</th>
<th>How is the food harvested or processed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>From trees</td>
<td>Picking them from trees</td>
</tr>
<tr>
<td>Milk</td>
<td>From cows</td>
<td>Milking them and flavoring</td>
</tr>
<tr>
<td>Chocolate</td>
<td>From milk (or goats)</td>
<td>Turning them into chocolate milk</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Market</th>
<th>Where does the food come from?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm</td>
<td>Apple orchards</td>
</tr>
<tr>
<td>Field</td>
<td>Cows on farms (or goats)</td>
</tr>
<tr>
<td>Transport</td>
<td>Milk is processed and flavored</td>
</tr>
</tbody>
</table>

**Local Dairy Fishery Orchard**
http://www.bbc.co.uk/food/0/23980594
K-3: What Are Objects Made Of?

- What objects do you need to survive?

- Can you classify those objects into living or nonliving?

- What does renewable and non-renewable mean?
What do you think each item is made from?
Dig A Little Deeper

What’s In A pencil Besides Wood?

The cedar wood is from the forests in California and Oregon. The graphite (not lead) might come from Montana or Mexico, and is reinforced with clays from Kentucky and Georgia.

The eraser is made from soybean oil, latex from trees in South America, reinforced with pumice from California or New Mexico, and sulfur, calcium, and barium.

The metal band is aluminum or brass, made from copper and zinc, mined in no less than 13 states and nine Canadian provinces.

The paint to color the wood and the lacquer to make it shine are made from a variety of different minerals and metals, as is the glue that holds the wood together.

How many countries does it take to make a pencil?

For information about minerals in society, go to:
Mineral Information Institute at www.mii.org

Math/Science: Count measure, classify, graph classroom pencils.
Writing: Acrostic poem “pencil pal” biography.

Dig A Little Deeper
A Bright Smile
From Toothpaste and Minerals

Toothpaste cleans your teeth and keeps them healthy.

The cleaning is done with abrasives (from rocks) that rub the plaque away. Abrasives are minerals like silica, limestone, aluminum oxide (also used in sandpaper), and various phosphate minerals.

Fluoride, used to reduce cavities, comes from a mineral called fluorite. It is sometimes changed into stannous fluoride (tin fluoride).

Most toothpaste is made white with titanium dioxide which comes from minerals called rutile, ilmenite, and anatase. Titanium dioxide also is used to make white paint.

The sparkles in some toothpaste come from mica, a mineral common in many rocks.

The toothbrush and tube holding your toothpaste are both made of plastics that come from petroleum (petrochemicals) and other minerals.

For more information about minerals in society, go to:
Mineral Information Institute, www.mii.org

Math: Survey class on brands used; chart or graph. Health: Discuss dental hygiene & special ingredients. P.E.: Stomp & squirt contest, use toothpaste & butcher paper.
FACT SHEET

What’s in my Cell Phone?

- Arsenic (gallium arsenide in the amplifiers and receivers). Mined in China, Chile, Morocco, Peru, Kazakhstan, Russia, Belgium, and Mexico.
- Copper (circuitry). Mined in Chile, United States, Peru, China, Australia, Russia, Indonesia, Canada, Zambia, Poland, Kazakhstan, and Mexico.
- Gallium (gallium arsenide). Mined in China, Germany, Kazakhstan, and Ukraine.
- Gold (circuits). Mined in China, United States, Australia, South Africa, Peru, Russia, Canada, Ural, Ghana, Papua New Guinea, Indonesia, Brazil, Mexico and Chile.
- Magnesium compounds (frame). Mined in China, Turkey, North Korea, Russia, Slovakia, Austria, Spain, Australia, Brazil, Greece, India and the United States.
- Palladium (circuits). Mined in Russia, South Africa, Canada, United States and South Africa.
- Platinum (circuits). Mined in South Africa, Russia, Canada, Zimbabwe, United States and Columbia.
- Silver (circuits). Mined in Peru, Mexico, China, Australia, Chile, Russia, United States, Poland, Bolivia and Canada.
- Tantalum (circuits). Mined in China, Russia, Canada, Austria, Bolivia and Portugal.
- A multitude of petroleum products are used in cellular phones.

INTERESTING FACTS

- About 100 million cell phones are retired annually in the United States. Collectively, these cell phones weigh about 1,400 metric tons. Annually retired cell phones contain about 2,100 metric tons of copper, 40 metric tons of silver, 130 metric tons of gold, 2 metric tons of palladium, and 0.04 metric tons of platinum.
- Recovery and recycling of cell phones are at the early stages of development, so it is not yet possible to recycle the materials in them.
- For cell phone recycling to be economically viable, efficient recovery infrastructure and product designs that simplify dismantling and recycling are needed to facilitate the growth of cell phone recycling.
- Gallium arsenide is used in the amplifier and receiver.
- Magnesium compounds are alloyed to make the cell phone casing.

To learn more about minerals and mining visit
www.MineralsEducationCoalition.org
12989E. Adams Aircraft Circle, Englewood, CO 80112
303-468-4300 • 800-763-3132

http://www.mineralseducationcoalition.org/minerals-your-life
Pasta Mining

- The activity engages the students in a simulation to help them understand how natural resources are depleted
  - Graphing
  - Resource Management
  - Predicting
As usual, Walter stopped at the bakery on his way home from school. He bought one large jelly-filled doughnut. He took the pastry from its bag, eating quickly as he walked along. He licked the red jelly from his fingers. Then he crumpled up the empty bag and threw it at a fire hydrant.

After dinner Walter took out the trash. There were two cans next to the garage. One was for bottles, one for cans, and one for everything else. As usual, Walter dumped everything into one can. He was too busy to sort through garbage, especially when there was something good on television.

Walter went to bed wishing he lived in the future. He couldn’t wait to have his own city plane, a robot to take out the trash, and a machine that could make jelly doughnuts by the thousands. When he fell asleep, his wish came true. That night Walter’s bed traveled to . . .
Walter woke up in the middle of a huge dump. A bulldozer was pushing a heap of bulging trash bags toward him. "Stop!" he yelled.

The man driving the bulldozer put his machine in neutral. "Oh, sorry," he said. "Didn't see you."

Walter looked at the distant mountains of trash and saw half-buried houses. "Do people live here?" he asked.

"Not anymore," answered the man.

A few feet from the bed was a rusty old street sign that read FLORAL AVENUE. "Oh no," gasped Walter. He lived on Floral Avenue.

The driver revved up his bulldozer. "Well," he shouted, "back to work!"

Walter pulled the covers over his head. This can't be the future, he thought. I'm sure it's just a dream. He went back to sleep.
• Teams = Mining Companies
  • Responsible for ONLY mining YOUR pasta type
• Timed Intervals
  • No Running, No Shoving
  • No Destroying or Taking Other Resources
• Return and Tally the Number of Pieces for Each Timed Trial
  • Create a Table
  • Develop a Graph
Teaching Through Trade Books

- Column published monthly in Science and Children.
- Connects children’s literature to science activities.
- A few columns are uploaded to the session materials webpage.
Outstanding Trade books in Science

- A joint project of the National Science Teachers Association (NSTA) and the Children's Book Council.

- Published March each year

http://www.nsta.org/publications/ostb/
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Session Materials:
http://webspace.ship.edu/caroyc/ConnectingScience&Literacy.html