Integrating Literacy Strategies into Science Instruction

Terri Sessoms
Thursday, March 29, 2012
1:30 p.m. - 3:00 p.m.
Integrating Literacy Strategies into the Science Instruction Program

Carolina™ Curriculum Leadership Series
NSTA 2012

Terri Sessoms
Johnston County Schools
Lucky You!
Went to a workshop this summer and now one more thing . . .

"Yea, though I walk through the valley of the shadow of death, I will fear no evil" Psalm 23
Session Goals

- Explore examples of current research and best practice in achieving literacy through science education
- Model strategies that demonstrate how reading, writing, and discussion promote science literacy
- Reflect on and discuss how to incorporate literacy into your strategic plan
What Do the Goals Mean?

• “Marry” existing literacy initiatives with improved science instruction

• Focus on how the research ties together – not one more piece on your teacher’s plate, but a vehicle for engagement with the Common Core/SCOS

• Improve academic performance in tested areas (science and reading) through reading and writing in the content areas
Research Shows . . .

• If teachers use literacy in the content area strategies 15-20 minutes (a couple of times each week), students increase reading levels and significantly improve performance on content area standardized testing.
Integrating Literacy and Science Streamlines the Research

- Marzano – Effective Learning Strategies
- Payne – Generational Poverty
  - Vocabulary Development
  - Background Knowledge
  - Random Language to Sequential Language
- Comprehension (McLaughlin & Allen, 2002; Rand, 2002; Harris & Hodges, 1995; Cambourne, 1995)
  - Predict
  - Retell
  - Clarify
  - Summarize
- Rigor and Relevance
  - Revised Bloom’s Taxonomy
  - Relevance – Read and Write About Science
Are Literacy and Science a Natural Fit?

• Reading and writing clarify learning points of science inquiry lesson

• Nonfiction/Informational Reading Requirements
  • EOG Reading – 60% Nonfiction
  • EOG Science – Vocabulary and Concepts
  • NAEP – 4th grade 50%
  • NAEP – 12th grade 70%
What Do Scientists Do?

80% of their time is devoted to reading and writing!

(Palincsar & Magnusson, 2000)
Personal Reflection

• Using your notebook, take a minute to reflect on:

  • What is literacy? Being literate?
  • What is scientific literacy?
Content Area Literacy

Defined as . . .

The level of reading, writing, and speaking skill necessary to read, comprehend, and respond to appropriate instructional materials in a given subject area.
Use of informational texts relevant to student inquiries as part of the literacy development . . .

– Inherently interesting to most students
– Motivates further reading
– Builds background knowledge (concept understanding and vocabulary) for future learning because it helps children learn about the world around them
– Basis for success throughout later years in school


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Comparison of Skills

Science
- Observing
- Predicting
- Inferring
- Comparing & Contrasting
- Communicating
- Classifying
- Collecting & Organizing Data
- Interpreting Data
- Linking Cause & Effect
- Formulating Conclusions

Reading
- Note Details
- Predicting
- Inferring
- Comparing & Contrasting
- Communicating
- Sequencing
- Summarizing
- Recognizing Main Ideas
- Recognizing Cause & Effect
- Drawing Conclusions

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Writing Skills and Science

Writing
• Compare and contrast
• Analysis
• Persuade and convince
• Cause and effect
• Problems and solutions
• Descriptions and observations
• Summaries

Science
• Interpreting data and graphs
• Annotated diagrams and drawings
• Procedures/processes
• Inferences
• Hypotheses
• Explanations/justifications
• Conclusions
• Focused free writing

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Importance of Experiential Learning and Background Knowledge

• Step 1: Read the given descriptive narrative and underline the important points.
• Step 2: Re-read the narrative and circle the important points from the perspective of a home buyer.
• Step 3: Re-read the narrative and draw a box around the important points from the perspective of a burglar.
• Which assignment was the hardest to do? Why?
Multiple logistic regression was used to examine the association between depression screening and the model variables hypothesized to be predictive of screening behavior. For this analysis, all significant variables from the bivariate analysis were entered into the regression as dichotomous variables.
5 Minute Glossary . . .

Explain vs. Define

- On chart paper . . .
  - List words that will be new to their speaking, listening, or reading vocabulary (key terms).
  - Explain in “kid friendly” terms what the word means.
  - Use movement whenever possible to engage student.
5 Minute Glossary

- Term – **Kid friendly explanation**
- Term – **Kid friendly explanation**
- Term – **Kid friendly explanation**
Text Navigation or Picture Walks – Before Reading . . .

- Direct students to look at titles, subtitles, captions, etc. Make a prediction about what the text will be about. Turn these pieces of text into questions.
- Direct students to look at a photo or other graphic text.
- Discuss the meaning the photo or graphic text holds. Use this to build background knowledge.
Look at the title. Tell a partner what you think this is going to be about. OR What do you want to know?

What is happening in the photo? Read the caption. How do you think this connects with magnetism?
This is an illustration of Earth's magnetic field. Notice the two sets of poles: magnetic and geographic. The geographic north and south indicate Earth's point of rotation. The magnetic poles are where Earth's magnetic force is greatest. Earth's magnetic poles are about 11 degrees from Earth's point of rotation. The north magnetic pole is in the southern hemisphere while the south magnetic pole is in the northern hemisphere.
READ IT IN THE ROCKS

At low temperatures, magnetite behaves like a small magnet, but if the temperature gets too high, magnetite loses its magnetic properties. So any magnetite present in the lava pouring out of an erupting volcano loses its magnetism.

Now here’s the interesting part. As lava cools, its magnetism returns because of the influence of the magnetic field surrounding the lava. A magnetic field is a way of describing the magnetic force produced by a magnet or current.

What magnet is causing the magnetic field? It’s Earth, which acts as a giant magnet. As the magnetite cools, it becomes magnetized in the direction of the Earth’s magnetic field.

Scientists use an instrument called a magnetometer to measure the direction and intensity of the lava rocks’ magnetism. They also use other techniques to determine the age of the rocks. With these measures, scientists can tell exactly in which direction Earth’s magnetic field pointed at the time that rock formed. Each time a volcano erupts, a new layer of rock forms on top of the old one. The layers record the movement of Earth’s magnetic poles over time.

A geologist collects lava rocks, which contain a mineral called magnetite.

N.C. Seidler, National Museum of Natural History, Smithsonian Institution
Challenges to Reading and Information Gathering in the Content Areas

- Concept Density – more ideas and skills in less time
- Specialized Vocabulary – unique and multiple meanings
- Readability – higher than student skill levels
- Length – longer and more comprehensive
- Graphs/Charts/Maps – complex information
- Non-Print Sources – online information
Scan the research in your handouts to review the research regarding effective instruction and literacy across content areas.

Identify 3 points you predict will be important to remember.

Be prepared to share those aloud and explain why you believe they are important to remember.
Most Effective Learning Strategies – McRel

- Identifying Similarities and Differences
  - Classification, Categorization
- Summarizing/Note taking
- Cooperative Learning
- Graphic Organizers
- Providing Appropriate Practice (Guided & Independent)
- Setting Objectives and Providing Meaningful Feedback
- Reinforcing Effort and Providing Recognition
Revised Bloom’s Taxonomy

- **Remembering**: can the student recall or remember the information?
- **Understanding**: can the student explain ideas or concepts?
- **Applying**: can the student use the information in a new way?
- **Analyzing**: can the student distinguish between the different parts?
- **Evaluating**: can the student justify a stand or decision?
- **Creating**: can the student create new product or point of view?
# Learning Activity Retention

<table>
<thead>
<tr>
<th>Learning Activity</th>
<th>Amount of Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teach Others/Use Learning</td>
<td>90%</td>
</tr>
<tr>
<td>Practice &amp; Real Application</td>
<td>75%</td>
</tr>
<tr>
<td>Discussion Group</td>
<td>50%</td>
</tr>
<tr>
<td>Demonstration</td>
<td>30%</td>
</tr>
<tr>
<td>Audio Visual</td>
<td>20%</td>
</tr>
<tr>
<td>Reading</td>
<td>10%</td>
</tr>
<tr>
<td>Lecture</td>
<td>5%</td>
</tr>
</tbody>
</table>

William Glasser, The Quality School
Research Connection Between Science and Literacy

Language is essential for effective science learning:

• Supports clarity of thought, description, discussion, and argument.

• Students make meaning by writing, talking, and reading about science, especially when accompanied by direct investigation of scientific phenomena.

• The ability to use language to form ideas, theorize, reflect, share, debate, and clearly communicate underpins student acquisition of science concepts and processes.

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Writers must record observations, organize knowledge, link evidence to claims, draw conclusions, and make connections to what was learned – and to scientific terms.
Seven Elements of Notebooking

1. Question/Problem/Purpose
2. Prediction
3. Developing a Plan
4. Observations, Data, Charts, Graphs, Drawings
5. Claims and Evidence
6. Drawing Conclusions
7. Reflection: Next Steps and New Questions

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Problem: 1) Can the volume of displaced water be predicted if the mass of a floating object is known?
         2) Can the volume of displaced water be predicted if the mass of a sinking object is known?

Procedure:
1) Measure mass of object and record.
2) Pour water into graduated cylinder and note volume.
3) Find displaced volume and record.

Hypothesis:
We will be able to predict because if the mass is known of the object, then we can probably predict the displaced water, since we could predict with the volume. We will experiment and see patterns.
Notebooking: Charts and Claims

### Data

<table>
<thead>
<tr>
<th>Name of Object</th>
<th>Float or Sink</th>
<th>Mass (g)</th>
<th>Volume of Displaced Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>wood</td>
<td>F</td>
<td>10g</td>
<td>8</td>
</tr>
<tr>
<td>skipper</td>
<td>S</td>
<td>11.2g</td>
<td>10</td>
</tr>
<tr>
<td>candle</td>
<td>F</td>
<td>9g</td>
<td>9</td>
</tr>
<tr>
<td>big rock</td>
<td>S</td>
<td>15.5g</td>
<td>13</td>
</tr>
<tr>
<td>small wood</td>
<td>S</td>
<td>3.7g</td>
<td>3</td>
</tr>
<tr>
<td>small rock</td>
<td>F</td>
<td>3.5g</td>
<td>4</td>
</tr>
</tbody>
</table>

### Results:

- They are not very many flags because people used different objects.
- The floaters make a positive correlation.
- A flotter with 10g displaces 13ml.
- A flotter with 7g displaces 7ml.
- Most sinkers are in the bottom left corner and above the floaters line of best fit.
Conclusions:
The problems being investigated were: 1. Can the volume of displaced water be predicted if the mass of the floating object is known? and 2. Can the volume of displaced water be predicted if the mass of a sinking object is known? The hypothesis was, it can be predicted because if the mass is known of the object, then you will be able to predict the displaced water since you could predict with the volume. We will experiment and see patterns. The data shows for the flotators, the mass of the object is the same as displaced volume. For the sunken, the volume for displaced water is less than the mass of the object. For example, a Federer with 15g displaces 15ml, also a Feeder with 5g displaces 5ml. Another example is a sunken with 5g displaces 5ml. The hypothesis was correct, because the line of best fit was drawn on the graph and it is possible to predict.

A possible source of error could be water on the triple-beam balance; it would cause the wrong mass. It could be solved by wiping a triple-beam balance with a paper towel after each use. Another possible source of error could be not zeroing the triple-beam balance; it could be solved by checking before each use or writing a zero on a

This connects to how people, because boat people need to know load/level it correctly, so the people in the boat won't sink. The question that this raises is: "If there is a chemical in the water, will the object sink differently?"
Primary and Elementary Teachers Should . . .

- 60% of text that students read or listen to is nonfiction.
- Picture Walks for nonfiction text (STC™ reading selections, Big Books, Weekly Readers, etc.): graphics such as subheadings, maps, charts, diagrams, etc.
- Use Graphic Organizers for nonfiction as shared reading and shared writing activities.
Research on Effects of Poverty on Learning . . .

- Students from poverty enter kindergarten with one-half of the speaking and listening vocabulary that their other classmates bring to school.
- Students from poverty “don’t get out much” – background information and vocabulary.
- By the time students from poverty enter 9th grade, they have one-fourth the vocabulary that their classmates have.
What Works Best in Schools? Why Can’t the Reading Teachers Do It All?

Marzano says . . .

• Involve students in a program of wide reading that emphasizes vocabulary development.
  • Content Reading – Wide reading opportunities each day in different subject areas expose student to many more words than basal reader or direct vocabulary list instruction (750–1500 words vs. 350 words per year).
Marzano Says . . . Content Area Terms/Vocabulary

- Provide direct instruction in vocabulary terms and phrases that are important to specific subject matter content.
  - Exposes student to content rich vocabulary, which is directly taught ahead of time to build comprehension.
  - Exposure to integrated and application-based vocabulary (higher levels than traditional text book vocabulary), which is directly taught as needed (mini lesson, glossary, dictionary, etc.).
Customer Focus

- U.S. Dept. of Education states there are 2 types of reading *all* workers must be able to do:

1. Comprehend reading materials related to daily core job responsibilities.

2. Read occupational materials related to organizations, trade journals, etc.
Behaviors of Good Readers

- Set goals for reading
- Make predictions
- Construct, revise, question
- Find meaning from context
- Integrate prior knowledge
- Monitor their understanding
- Read different kinds of texts differently

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Characteristics of Poor and Successful Readers

- Poor Readers
  - Think understanding occurs from “getting the words right.”

- Successful Readers
  - Understand that they must take responsibility for constructing meaning using prior knowledge.
Characteristics of Poor and Successful Readers

- **Poor Readers**
  - Have a relatively low self-esteem.

- **Successful Readers**
  - Have self-confidence that they are effective learners.
Successful Comprehension: Before Reading

- Activating background knowledge
- Investigating text structure
- Setting a purpose for reading
- Predicting text content
- Reviewing and clarifying vocabulary
Successful Comprehension: During Reading

• Establishing the purpose for each part of the reading
• Self-monitoring
• Visualizing
• Summarizing
• Confirming, rejecting predictions
• Identifying and clarifying key ideas
• Questioning self
Successful Comprehension: After Reading

• Assessing if purpose of reading was met
• Paraphrasing important information
• Identifying the main idea and details
• Making comparisons
• Connecting
• Drawing conclusions
• Summarizing
• Analyzing
Science and Reading Literacy

• If reading informational text for understanding is best . . .
  – within the discipline (e.g., science)
  – within the real-world context (e.g., electric circuitry)
  – within the science activity (e.g., building a flashlight)

• Then how and where would you use it in teaching an inquiry science lesson?
Format for Lesson Integration

- **Focus** – Text Navigation, 5 Minute Glossary, etc.
  - Build background knowledge, vocabulary, and engagement through predictions and prior knowledge

- **Explore** – Inquiry, Hands-On Science

- **Reflect** – Notebooking (teacher modeling is a must)
  - Written justification, analysis, definition

- **Apply** – STC™ Reading Selection with Strategy (teacher modeling is a must)
  (Anticipation Guide, Concept Map, Cornell Note taking, Savings and Loans)
  - Reinforce and clarify Big Idea
Making Time for Integration

• Science Time
• Literacy Block Time – read, write, and talk about science
  • Writing Time
  • Small Group Literacy Time
  • Whole Group Literacy Time
  • Guided Reading Groups
  • Research Centers
Literacy Whole Group Time

- Rehearsing science vocabulary already learned (reading the room, games, etc.)
- Building Word Walls
- STC™ reading selection with literacy strategy
- Model science text vocabulary and comprehension with graphic organizers
- Read Aloud – related science informational text for comprehension and vocabulary development (think/pair/share)
- Morning Message – Big Idea
Flex Groups/Literacy Centers

- Flex Groups – teach skills that will be reinforced in whole group and literacy centers
  - 15-20 minutes – Science concepts and terms in text for phonemics, decoding, guided reading, comprehension
- Literacy Centers – Science Text
  - Research – Big Idea in science
  - Spelling – science vocabulary
  - Graphic Organizers – science reading selection
  - Fluency with science text
  - High Frequency Words – science
  - High Frequency Phrases – science
Strategies with Text

- 5 Minute Glossary
- Text Navigation/Picture Walk
- Word Wall Games – Science Terms
- Savings and Loans
- Vocabulary Builders – Cloze
- Anticipation Guides
- Concept Maps
- Cornell Graphic Organizer
Anticipation Guides

- Identify concepts you want students to learn from the reading.
- Create 4-6 statements that support or challenge beliefs or experiences.
- Before reading the text, have students read and code each statement as to whether the text will agree or disagree with each statement (predictions, prior knowledge).
Anticipation Guides

- Have students read the selection to find evidence that either supports or disconfirms each statement.
- While reading, students may change coding.
- Partners share their coding and refer back to text to prove accuracy.
- Discuss what was learned from reading.
- Have students rewrite false statements to make them true (individually, partners, or whole group).
Changes in Earth’s circulation patterns in the inner core cause the magnetic poles to change location.

The geographic north pole is now located in Antarctica.

The magnetic south pole is located approximately 11 degrees from the northern point of rotation.

Scientists predict that the Earth will flip upside down when the poles change.
Cloze Directions

• Read the cloze passage and see how many blanks you can fill in using prior knowledge.

• Read the complete text passage silently and look for information that would fill in blanks.

• Turn over the complete passage, read the cloze, and fill in/change blanks.

• Compare the pre- and post-reading results.
Scientists use an instrument called a **magnetometer** to measure the **strength** and intensity of the lava rocks’ magnetism. With these measures, scientists can tell exactly in which direction Earth’s **magnetic field** pointed at the time that this rock was formed. Layers of volcanic rock record the movement of Earth’s magnetic **directions** over time.
Scientists use an instrument called a magnetometer to measure the direction and intensity of the lava rocks’ magnetism. With these measures, scientists can tell exactly in which direction Earth’s magnetic field pointed at the time that this rock was formed. Layers of volcanic rock record the movement of Earth’s magnetic poles over time.
Concept Definition Map

- Write the term “magnetism” (concept) in the center of your concept map.
- Read the text about viruses (concept) to find information to fill in the parts of the concept map.
- Compare your map with a partner’s map, use text to defend, and adjust as needed.
- Debrief with class and then write a one-paragraph definition of “magnetism.”
What category is it in?

What is it different from?

What are its properties?

Examples:
Magnetism

Examples:
Lodestone
Earth
Volcanic rock

What category is it in?
Force

What is it different from?
Gravity

What are its properties?
Strength
Repel
Attract
Cornell Graphic Organizer

- With a partner or group, survey passage (title, subheadings, captions, pictures, first and last sentences).
- Develop questions from the above and write in the first column.
- Read passage and highlight details that will help answer questions.
- When you finish reading, use information to answer questions (second column).
Cornell Graphic Organizer

- As a group, discuss the details/answers you recorded in the second column and determine a main idea (What do all of these details have in common?) and write the main idea in the third column.
- Use the self-evaluation key and code your details and questions.
- Prepare a group presentation for the class on your section of the reading passage.
**Cornell Graphic Organizer**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Details</th>
<th>Main Idea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pg. 60: Why is there a photo of hot lava?</td>
<td>Lava contains magnetite. When it is cool, it behaves like a small magnet.</td>
<td>Geologists study volcanic rock to determine the movement of Earth’s magnetic poles.</td>
</tr>
<tr>
<td>Pg. 61: How do geologists read rocks?</td>
<td>They use a magnetometer to measure the lava rock’s magnetism.</td>
<td></td>
</tr>
<tr>
<td>Pg. 62: How is the geographic pole different from the magnetic pole?</td>
<td>Geographic pole tells the earth’s point of rotation. Magnetic poles are where the Earth’s magnetic force is greatest.</td>
<td></td>
</tr>
</tbody>
</table>

**Self Assessment Key:**
- Check mark = I know this.
- ? = I have a question about this.
- ● = I need to review this more.
Next Steps for Science Literacy

• Science Notebook – take a minute to quietly write:
  • Something new that you learned about science literacy that you will share with your team
  • An action you will take – where does literacy fit into your strategic plan? How will you enact effective reading and writing into your strategic plan?
Session Goals

• Explore examples of current research and best practice in achieving literacy through science education
• Model strategies that demonstrate how reading, writing, and discussion promote science literacy
• Reflect on and discuss how to incorporate literacy into your strategic plan
Science and Literacy: A Winning Combination!