Formative Assessment in the Elementary School

Science Notebooks, Claims & Evidence, and RAISE

In light of the newly released and state adopted National Common Core Standards for Literacy in Science, student use of science notebooks is critical every day, K-12 based on numerous research studies. Also, their use is in support of one of the North Smithfield District's overall goals to support the improvement of students' achievement with respect to their writing abilities.   Students must develop effective, in depth, and extended writing responses on demand, including Rhode Island's NECAP testing in science as well as other content areas.

The district also has introduced and adopted the **RAISE** model for effective writing in numerous workshops. The implementation of this model, when used with the East Bay Educational Collaborative's **Scientist's Notebook** pedagogical workshop model of instruction for inquiry based science, will translate ultimately to students developing their abilities to write highly effective scientific conclusions for all inquiry experiences. It will also develop their abilities to communicate clearly their scientific conceptual understandings.

The RAISE model is in complete alignment with the use of Science Notebooks/journals and can be used with them to help students develop, practice, and refine their science understanding, while also enhancing reading, writing, mathematics and communications, to meet these new standards. As teachers involve students in inquiry-based science investigations, the need to communicate science learning in new ways has become evident. If students are encouraged to communicate their understanding of concepts through science notebook writings, these notebooks can be an effective strategy to help students learn science. Research has shown that science notebook writing may also be a way for students to strengthen their language skills as they develop an understanding of the world around them. Science notebooks allow teachers to formatively assess students' understanding and provide the timely feedback students need for improving their performance.

Science notebooks contain a record of information about the students' classroom inquiry experiences and are encouraged to use them as scientists would, before, during, and after all investigations. They are a place where students formulate and record their questions, make predictions, record data, procedures, and results, compose reflections, and communicate findings. Most importantly, notebooks provide a place for students to record new concepts they have learned.

Excellent sources of information about the use of notebooks are the East Bay Educational Collaborative's website at www.ebecri.org and "Using Science Notebooks in the Elementary Classroom" by Dr, Michael Klentschy NSTA Press whose research (among many others) supports this work..

A Comparison of RAISE* and how it fits with the Scientist's Notebook Model of Instruction* when students write their *scientific conclusion and Constructed Responses for NECAP-RI type assessments:* *RAISE details are courtesy of Clare Arnold, North Smithfield District Curriculum Director Scientist's Notebook Model details are provided by the East Bay Educational Collaborative

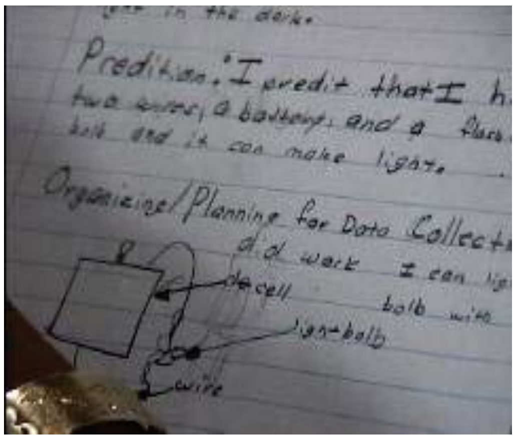
RAISE	Scientist's Notebook Model Effective Conclusion Writing
Writing Prompt	Engaging Scenario for investigation
Focus/Essential Question for Writing	Focus/Essential Question that was investigated
Restate Students are to use (restate) the words from their question	Student rewrites the question as a declarative statement to begin their response.
Answer Students write the required amount of answers to the question	Students re-state their prediction/hypothesis that is a response to the focus/essential question and state what they thought would happen in the investigation and why they thought that answer to the focus question.
Include:	Students include in the body of their conclusion:
Support with Evidence: Students must support (prove) each and every answer with evidence from the text used. (This is the most important and most challenging part of construted-response!)	Students include their claims/inferences based on their evidence recorded in their investigation. They also include when appropriate other student claims that may have differed from their own and comment on why there may have been differences. They include description of their analysis of their data.
Extend: Students give extra thought about the answer;this can be analysis, judgement, or personal connection to the text.	Students provide reflections on their investigation including analysis of how they might improve their investigation and/or other questions that they might research. At secondary grades students should consider sources of error in measurements, etc. Students provide closure to their conclusion by restating again the beginning of their response in different words….but, beginning this final sentence/statement with the words "In conclusion…"

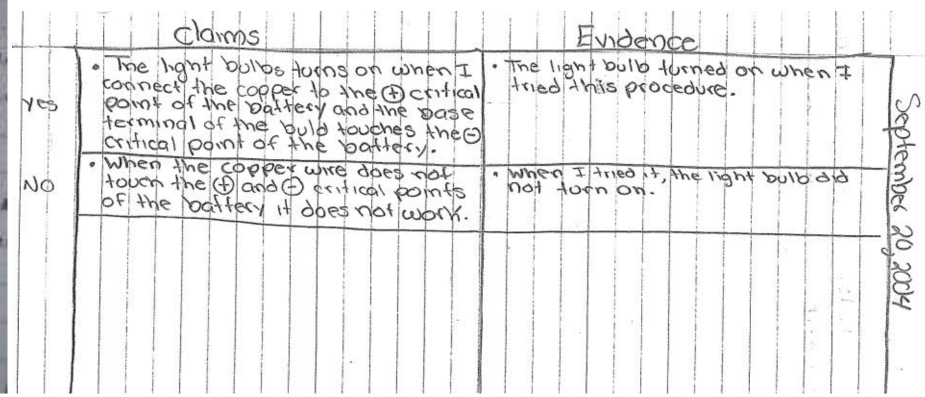
Science conclusions should be developmentally appropriate and consistent with expectations of other content areas. Conclusions should be three or more paragraphs including paragraphs devoted to: Focus/Controlling idea, Evidence & Claims details, and paragraph(s) that focus on analysis done, and reflections.

- The primary formative assessment device to be used at the elementary level is the strategic use of science notebooks and related entries as shown below. Quality effective and timely feedback to students is critical to improving student achievement. The notebooks provide that opportunity.

- The use of NE#CAP-RI released tasks with students also provide an excellent opportunity to provide formative assessment.

Science Notebook or Journals Student Entry Types-*The Reading & Writing Connection*





Science notebooks contain information about students' classroom experiences as they construct scientific knowledge/concepts. They are used much as scientists would, before, during, and after all investigations. They are a place where students formulate and record their questions, make predictions, record data, procedures, and results, compose reflections, and communicate findings. Most importantly, notebooks provide a place for students to record new concepts they have learned.

The research supporting the use of notebooks is extensive but, here are a few resources that support this important facet of instruction. Klentschy, M. and Molina-De La Torre, E. (2004). Students' science notebooks and the inquiry process. In W. Saul (Ed.). Crossing Borders in Literacy and Science Instruction: Perspectives on Theory and Practice. Newark, DE: International Reading Association Press. Students benefit from strong scaffolding with respect to building explanations from evidence (Songer and Lee, 2003)

Further, by reviewing hundreds of actual student notebooks, a group of education leaders from the East Bay Educational Collaborative,   Dr. Michael Klentschy, and others from Washington State explored how teachers were asking students to record their ideas in their science notebooks. Analysis of the student work revealed eight distinct strategies or "entry types," used most frequently by practicing K-12 teachers. The following describes those eight entry types and offers a rationale for why a teacher might select a given entry type.   These types of entries are particularly important to connect science to reading and particularly writing.

Entry Type	***Definition and Purpose***
Glossary Development by Students	In conjunction with a "Word Wall" or "Object Wall" (which is the same except whenever possible the actual object is also clipped to the wall especially at lower grades and where English Language Learners are present) students develop their own definitions asnew words are used in context of investigations and classroom activities.
Drawings	*Definition* Student generated drawings of materials, scientific investigation set-up, observations, or concepts. Three common types of drawings used in science notebooks include: 1. Sketches: Informal pictures of objects or concepts created with little detail. 2. Scientific Illustrations: Detailed, accurate, labeled drawings of observations or concepts. 3. Technical Drawings: A record of a product in such detail that someone could create the product from the drawings.
	Purpose Students use drawings to make their thinking and observations of concrete or abstract ideas visible. Drawings access diverse learning styles, allow entry to the writing process for special needs students and emergent writers, and assist in vocabulary development (e.g. oral explanations, group discussions, labels).
Tables, Charts, and Graphs	*Definition* Formats for recording and organizing data, results, and observations.
	Purpose Students use tables and charts to organize information in a form that is easily read and understood. Recording data in these forms facilitates record keeping. Students use graphs to compare and analyze data, display patterns and trends, and synthesize information to communicate results.

Graphic Organizers	*Definition* Tools that illustrate connections among and between ideas, objects, and information. Examples include, but are not limited to, Venn diagrams, “Box–and-T” charts, and concept maps.	
	Purpose Graphic organizers help students organize ideas to recognize and to communicate connections and relationships.	
Notes and Practice Problems	*Definition* A record of ideas, observations, or descriptions of information from multiple sources, including but not limited to direct instruction, hands-on experiences, videos, readings, research, demonstrations, solving equations, responding to guiding questions, or developing vocabulary.	
	Purpose Students use notes and practice problems to construct meaning and practice skills for current use and future reference.	
Reflective and Analytical Entries	*Definition* A record of a student’s *own* thoughts and ideas, including, but not limited to initial ideas, self-generated questions, reflections, data analysis, reactions, application of knowledge to new situations, and conclusions.	
	Purpose Students use reflective and analytical entries to think about scientific content from their *own* perspective, make sense of data, ask questions about their ideas and learning processes, and clarify and revise their thinking.	
Inserts	*Definition* Inserts are artifacts placed within a notebook, including, but not limited to photographs, materials (e.g. flower petals, crystals, chromatography results), and supplemental readings (e.g. newspaper clippings).	
	Purpose Students use inserts to document and to enrich their learning.	

Investigation Formats	*Definition* Scaffolds to guide students through a controlled investigation, field investigation, or design process. Examples include, but are not limited to investigation planning sheets or science writing heuristics.
	Purpose Students use investigation formats to guide their thinking and writing while they design and conduct investigations. Students also use these formats to reflect on and discuss their findings and ideas.
Writing Frames	*Definition* Writing prompts used to focus a student's thinking. Examples include, but are not limited to, "I smelled…I felt…I observed…","My results show…", "The variable I will change is…", or "I think that because…".
	Purpose Students use frames to organize their ideas, prompt their thinking, and structure their written response. Frames help students become more proficient in scientific writing and less reliant upon the prompts.

Further, the following pedagogical model takes the use of notebooks to another level for students. It develops the ability of students to formulate claims or inferences based on evidence as scientists do and constant with the new Common Core Standards.

Specific examples of teacher strategies for Scientist's Notebook and other science-literacy connections used by classroom teachers may be found at EBEC's website:

http://ebecri.org/content/checklists

The “Scientist’s Notebook” Model of Instruction K-12

Constructing scientific knowledge is not a casual but a purposeful activity based upon posing questions, determining claims, and providing evidence. K.A.Burke, Iowa State University **The Process of Using Inquiry and the Science Writing Heuristic***

The “Scientist’s Notebook” method used in science classes, as a model of instruction (K-12), incorporates and facilitates student scientific writing development based on their claims and supporting evidence for those claims. Students are asked to support any and all claims with evidence gleaned from their investigation of a ***focus question.*** Students share their claims and evidence in a ***“making meaning conference”*** prior to actually writing conclusions. This models the actual work of scientists as they investigate and share and report the results of their work.

Elements:

- Engaging Scenario: (Optional but it is based on the research of Madeline Hunter in literacy.
- Focus Question: (a question that is investigable.)
- Hypothesis/Prediction with reasoning for the prediction based on student prior knowledge.
- Planning: Procedures can be based on “guided inquiry” questions developed by the teacher or later “self-determined inquiry” where students develop their own procedures. Opportunities to differentiate instruction based on the needs of students can occur in classrooms such as providing an explicit procedure to Sp.Ed. students where they can “test” it for the rest of class.
- Data and Evidence: Graphic Organizer development with students, tables, graphs, written observations. Hint: Data may not always be evidence to support a claim. An example might be in an experiment to measure the boiling point of a liquid the length of the thermometer can be collected as data but, it is not evidence for the investigation.
- Claims and Evidence
- Making Meaning Conference: Develop class claims and evidence
- Conclusions and Reflections

  SAMPLE Claims & Evidence

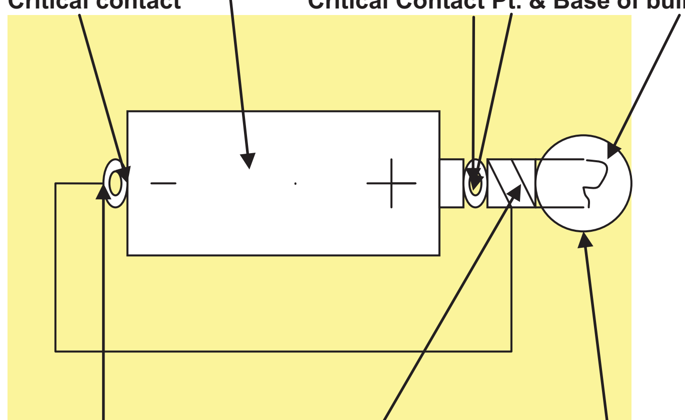
Components of a Scientist’s Notebook Activity	Purpose	Writing Scaffold

I claim that:

A complete circuit requires “critical contacts” at the positive and negative ends of a battery.

Based on my investigation I found that:

The base of the bulb is a critical contact point and the “screw threaded contact area” (anywhere) is a critical contact point to make the light bulb work.



When we connected the bulb as shown above the light worked no matter where the wire touched the side area of the threaded base of the bulb as long as the base or bottom of the bulb was in contact with the positive end.

It also worked when the ends of the battery were reversed. (reverse diagram) rsk-2005

Focus or Essential Question	The question provides a link to the engaging scenario, cannot be answered "yes" or "no" and is investigable	*How does…..?How can…?* *What does….?What can ..?* *Which….?*
Prediction	The prediction provides a reasonable explanation by the learner as to the result of the investigation. Using "because" also activates prior knowledge.	*I think …..will happen because………*
Planning -operational	The general plan determines which variable will be changed and which will be kept constant and what will be observed or measured. The operational plan describes the sequence of events and the materials that will be used to conduct the investigation.	*…. will be changed.* *…. will be kept the same.* *…. will be observed or measured.* operational *First…..* *Second…..* *Next ……* *Finally …..*
Data –	Data charts, tables, graphs and labeled diagrams and	How are we going to record what we are going to observe or

Observations/Measurements	illustrations	measure?
Claims/Evidence	Claims linked to the data collected or observed with justification.	*I know that …….* *I know this because….*
Conclusion	Revisit prediction. What was learned from the evidence?	*My evidence supports my prediction because …* *My evidence does not support my prediction because ….* *In conclusion, …* *Today I learned …*
Reflection	Provides an opportunity for the student to think about their thinking.	*Questions that I have now are …… .I wonder if …….What really surprised me about this investigation was ….I used to think, but now I think….I know that I'm*

OTHER RESOURCES:

MISC. VOCABULARY Commonly Used on Elementary NECAP Science Test

Compare Contrast Characteristics Classify Describe Effects Fair Test Inherit Investigation Occur Properties Structure(s)

For Response Questions - Phrases Such As:

* Cite evidence

* Use your data to explain your answer.

* Explain how your data did or did not support your prediction

FOSS RESOURCES WITH KITS

FOSS Science Stories are original student books developed specifically to complement the FOSS modules. The books integrate reading and language arts skills in the context of learning science. With FOSS, students first explore science concepts through hands-on investigations. Then they extend and reinforce their classroom discoveries and vocabulary with FOSS Science Stories.

FOSS Science Stories for grades K-2 are designed around large, colorful, instructive photographs. The text relates directly to the images, calling attention to particular details, suggesting comparisons, and moving students to think critically about the images. The stories are written mainly in an expository format to help build essential reading skills. FOSS Science Stories for primary grades are available in student book and teacher big book editions.

FOSS Science Stories for grades 3 - 6 use a variety of writing styles, accompanied with full-color illustrations and photos to enrich the science experience. The literature styles include
Narrative tales. Fictional adventures in which the main characters have experiences that relate to the science that students learned in class.
Expository articles. Informative articles that increase students' knowledge about science.
Technical readings. Selections that describe detailed procedures and provide precise explanations of principles.
Historical accounts. Stories about important people and events that shaped the development of science and technology.

www.fossweb.com

The www.fossweb.com web site opens new horizons for teachers, students, and families, in the classroom or at home. Each grade 3 - 6 module has an interactive site where students and families can find instructional games and interactive simulations. Those interested in visiting web sites related to the content of any FOSS module can select a link and explore the subject in greater depth.