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..

- The primary formative assessment device that is being used at the elementary level is the strategic use of science notebooks and related entries as shown below. Middle School Science instruction should build on the same practices deepening opportunities for students to engage in rigorous thinking expressed through their writings. 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.

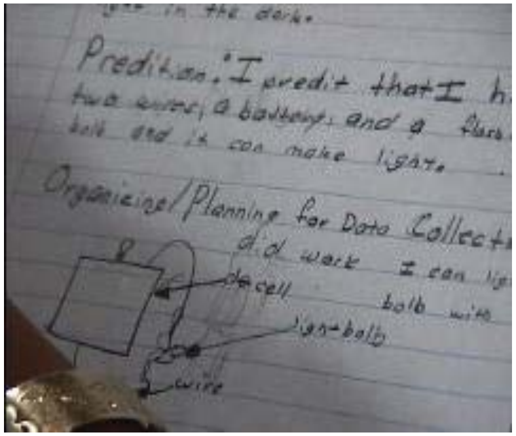
A Comparison of RAISE* and how it fits with the Scientist's Notebook Model of Instruction* when students write their *scientific conclusion and Constructed Responses for NECAP-RI type assessments:* *RAISE details are courtesy of Clare Arnold, North Smithfield District Curriculum Director
Scientist's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

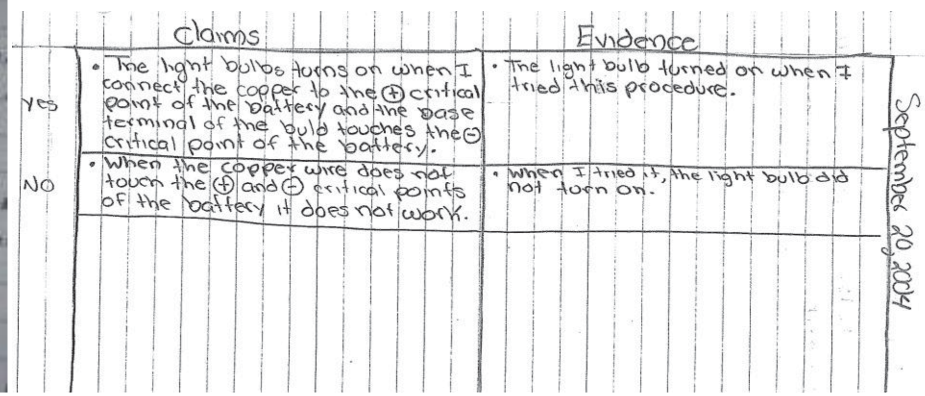
RAISE	Scientist's Notebook Model Effective Conclusion Writing
Writing Prompt	Engaging Scenario for investigation
Focus/Essential Question for Writing	Focus/Essential Question that was investigated
Restate Students are to use (restate) the words from their question	Student rewrites the question as a declarative 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: **(See below)**	Students include in the body of their conclusion: **(See below)**
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.

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

(Note: These are elementary student samples and middle school teachers will be expected to develop their own exemplar papers)





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, below 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	<u>*Definition*</u> 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.
	<u>*Purpose*</u> 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	<u>*Definition*</u> Formats for recording and organizing data, results, and observations.
	<u>*Purpose*</u> 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.

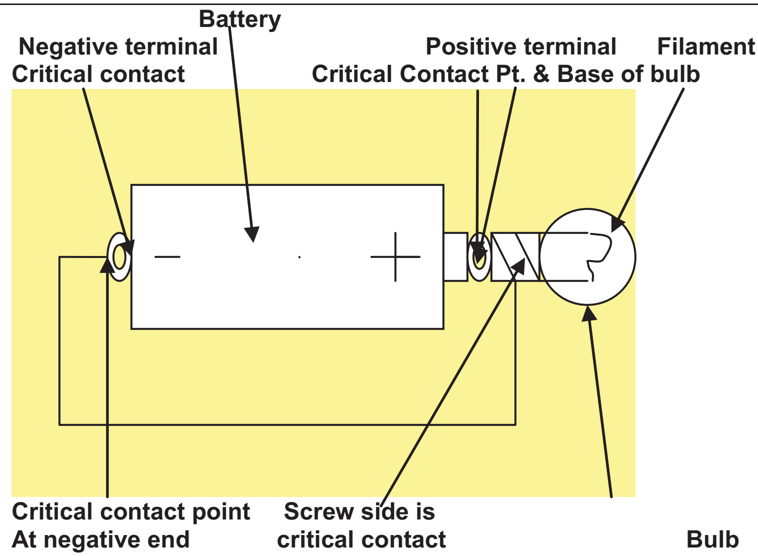
- Planning: Procedures can be based on “guided inquiry” questions developed by the teacher or later “self-determined inquiry” where students develop their own procedures. Opportunities to differentiate instruction based on the needs of students can occur in classrooms such as providing an explicit procedure 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

<table>
<tr>
<td>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.</td>
<td>

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</td>
</tr>
</table>

Scientist's Notebook Components	Purpose	Writing Scaffold
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 – Observations/Measurements	Data charts, tables, graphs and labeled diagrams and illustrations	How are we going to record what we are going to observe or 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*

Reference Table for NECAP High Emphasis Assessment Targets

Table 2: High-Emphasis Assessment Targets with *Preliminary* DOK Ceilings*			
Science Domains by EK Statement	**Grade 4 Targets with DOK**	**Grade 8 Targets with DOK**	**Grade 11 Targets with DOK**
LS1 Survival of organisms	1 – DOK 2a, b, g 2 – DOK 1a, b	1 – DOK 3h 2 – DOK 2a	1 – DOK 3d 2 – DOK 3d
LS2 Matter and energy in ecosystems	6 – DOK 2a	5 – DOK 2a, d 6 – DOK 2a	3 – DOK 2a
LS3 Organisms change over time		8 – DOK 2a, h	8 – DOK 3a, f
LS4 Humans are similar, yet unique	8 –DOK 2a, h	11 – DOK 2a, b	
PS1 Properties and structure of matter	1 –DOK 3h	1 –DOK 2a, c, d, e, i 2 –DOK 2e, g, j 4 –DOK 2a, b	3 –DOK 2a, b 4 –DOK 3c, g, j
PS2 Energy		6 –DOK 3c, j, l, o	6 –DOK 3a, c, h
PS3 Forces and motion	7 –DOK 2a, j	8 –DOK 2a, e, g, i, j,	8 –DOK 3a, c, h 9 –DOK 2a, b 10 –DOK 2a
ESS1 Earth and earth materials	1 –DOK 2b, e, g 2 –DOK 3c, h 4 –DOK 2a, b 5 –DOK 2a, b	2 –DOK 2a 3 –DOK 2a, b 5 –DOK 3c, d, h, k	1 –DOK 3a, c, d, f, l 3 –DOK 3o
ESS2 Solar system		6 –DOK 2a, g, h, j 8 –DOK 3j, o	
ESS3 Universe and galaxies			6 –DOK 3b, c, d, l, o 7 –DOK 3o 8 –DOK 2a, b

*** See Table 3 on the next pages for a description of Depth of Knowledge (DOK) levels in science. Coding for DOK ceilings are aligned with the descriptions in this Table. For example, “2a” means Level 2 DOK and the description for “a” – Specify and explain the relationship between facts, terms, properties, or variables.**

Table 3: Sample Descriptors for each of the DOK Levels in Science, based on the work of Norman Webb

Level 1 **Recall & Reproduction**	**Level 2** **Skills & Concepts**	**Level 3** **Strategic Thinking**	**Level 4** **Extended Thinking**
a. Recall or recognize a fact, term, definition, simple procedure (such as one step), or property b. Demonstrate a rote response c. Use a well-known formula d. Represent in words or diagrams a scientific concept or relationship e. Provide or recognize a standard scientific representation for simple phenomenon f. Perform a routine procedure, such as measuring length g. Perform a **simple** science process or a set procedure (like a recipe) h. Perform a clearly defined set of steps i. Identify, calculate, or measure **NOTE: If the knowledge necessary to answer an item automatically provides the answer, it is a Level 1.**	a. Specify and explain the relationship between facts, terms, properties, or variables b. Describe and explain examples and non-examples of science concepts c. Select a procedure according to specified criteria and perform it d. Formulate a routine problem given data and conditions e. Organize, represent, and compare data f. Make a decision as to how to approach the problem g. Classify, organize, or estimate h. Compare data i. Make observations j. Interpret information from a simple graph k. Collect and display data **NOTE: If the knowledge necessary to answer an item does not automatically provide the answer, then the item is at least a Level 2. Most actions imply more than one step.** **NOTE: Level 3 is complex and abstract. If more than one response is possible, it is at least a Level 3 and calls for use of reasoning, justification, evidence, as support for the response.**	a. Interpret information from a complex graph (such as determining features of the graph or aggregating data in the graph) b. Use reasoning, planning, and evidence c. Explain thinking (beyond a simple explanation or using only a word or two to respond) d. Justify a response e. Identify research questions and design investigations for a scientific problem f. Use concepts to solve non-routine problems/more than one possible answer g. Develop a scientific model for a complex situation h. Form conclusions from experimental or observational data i. Complete a multi-step problem that involves planning and reasoning j. Provide an explanation of a principle k. Justify a response when more than one answer is possible l. Cite evidence and develop a logical argument for concepts m. Conduct a designed investigation n. Research and explain a scientific concept o. Explain phenomena in terms of concepts	a. Select or devise approach among many alternatives to solve problem b. Based on provided data from a complex experiment that is novel to the student, deduct the fundamental relationship between several controlled variables. c. Conduct an investigation, from specifying a problem to designing and carrying out an experiment, to analyzing its data and forming conclusions d. Relate ideas *within* the content area or *among* content areas e. Develop generalizations of the results obtained and the strategies used and apply them to new problem situations **NOTE: Level 4 activities often require an extended period of time for carrying out multiple steps; however, time alone is not a distinguishing factor if skills and concepts are simply repetitive over time.**