Science Notebooks

…a tool for increasing student understanding of inquiry and science content
…a tool for enhancing literacy skills

JCPS Analytical and Applied Sciences

Jefferson County Public Schools
Shaping the Future

Table of Contents

Advantages of Science Notebooks

Advantages for Students

Science notebooks are a learning tool for students to record their thinking and learning.

- Chronological record of an investigation
- Record of questions and ideas for future investigation
- Learner-constructed reference and resource for later discussion, review, or final products
- Rough draft with the primary audience being the student
- Written reflections to clarify a student's understanding of key scientific ideas
- Opportunity to self assess/peer assess understanding of concepts or skills

Advantages for Teachers

Science notebooks are a tool for teachers to support student learning.

- Formative or summative assessment providing evidence of student learning in content, process, and ability to communicate
- Portfolio of learning to be shared with parents
- Opportunity to teach specific skills related to writing, scientific inquiry or math
- Integration of meaningful opportunities to practice expository writing
- Planning tool for the direction of the next steps of instruction

How Should a Science Notebook Be Organized?

Science Notebook Configuration

General Ideas:

1. Notebooks are meant to have portability. Students should be able to carry them from place to place.
2. Notebooks are considered a draft and may reflect a student's personal style.
3. Pages are numbered so students can find important entries.

Suggested Sections

1. **Table of Contents**
    a. Three to five pages
    b. A reference for the student scientist
    c. Created as work is completed by the student
    d. Meaningful for the student and reflect the work done in class
2. **Investigations**
    a. A chronological dated record of student work
    b. This section contains a variety of written entries showing the student's work before, during, and after investigations. The following is a sample selection of types of writing used in notebooks:

note taking	descriptions	sketches
questions	predictions	answers
procedures	diagrams	captions
recounts	data tables	charts
conclusions	summaries	field notes
compare/contrast	explanations	

    c. As you teach the investigation, the students record their work.
        Question, prediction, materials list, procedure, data and observations, conclusion
    d. It is not necessary to have students write up every investigation from beginning to end
    e. Student reflections on their learning of the essential understandings of the investigation, "What I learned" as well as "I wonder" questions are found in this section.
3. **Vocabulary**
    a. A collection of words identified as new vocabulary during the course of investigations.
    b. Meaning is constructed through the inquiry process.

Considerations for Planning Science Writing

- What are the **big ideas** of the lesson and how does that build into the conceptual story of the module unit?
- What is it that we expect students to know **and be able to do** at the end of the investigation?
- How can we use the **guiding questions** from the lesson or design **reflective questions** to support student processing of their own learning?
- What **misconceptions** or **difficulties** could students face in terms of understanding the content?
- What will the teacher need to **model before the lesson** to support student success in science writing?

What should teachers consider in designing extended writing experiences in science?

- **Concept and Skill Development**
  How will writing this entry help develop the students' conceptual understanding and scientific skills?

- **Organization of Information**
  Will certain strategies or types of entries help students organize their thinking and make sense of what they are learning?

- **Building Explanations**
  What writing frames or structures can be used to help students describe and explain the new conceptual understanding?

Inquiry Framework for Elementary Science Notebook

Helping Students Organize Their Thinking

Question/Problem

- Relate to "big ideas" and reflect standards
- Are clear and concise
- Can be investigated

Prediction (when appropriate)

- Proposes a possible answer to question or problem
- Connects to prior experience
- Gives a reason "because"

Data/Observation

- Recorded in students' own words
- Are organized, accurate, complete and detailed
- Includes appropriate tables, charts, graphs and diagrams

Conclusion (Wrap Up)

- Written in students' own words
- Answers question and supports it with evidence from investigation (data, observations)
- Compares results with predictions (when appropriate)
- Includes claim-evidence-reasoning statement (when appropriate)
- Includes clear summary of meaning of the data

Reflection

- Generated by students
- Includes "I Wonder" questions

Inquiry Framework for Middle School Science Notebook

Helping Students Organize Their Thinking

Question/Problem

- Relate to "big ideas" and reflect standards
- Are clear and concise
- Can be investigated

Prediction (when appropriate)

- Proposes a possible answer to question or problem
- Connects to prior experience
- Gives a reason "because"

Planning/Procedure

- Lists materials to be used (only when students design the investigation)
- Sequences steps logically to answer the question (only when students design the investigation)
- Written before investigation; may be revised after
- Identifies variables and control (when appropriate)
    - What should be changed? (Independent Variable)
    - What should stay the same? (Control)
    - What should be observed or measured to determine the effect of the changed variable? (Dependent Variable)
- Determines organizational method for recording observations or data (when appropriate)

Data/Observation

- Recorded in students' own words
- Are organized, accurate, complete and detailed
- Includes appropriate tables, charts, graphs and diagrams

Conclusion

- Written in students' own words
- Answers question and supports it with evidence from investigation (data, observations)
- Compares results with predictions (when appropriate)
- Includes claim-evidence-reasoning statement (when appropriate)
- Includes clear summary of meaning of the data

Reflection

- Generated by students
- Includes "I Wonder" questions
- Proposes next steps for further investigation

Indicators of Effective Science Notebooking

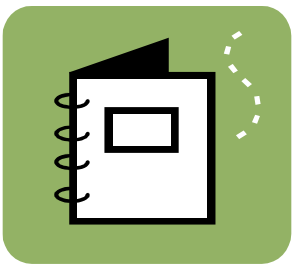
In classrooms where notebooks are fully implemented, observable indicators are:

- Organizing devices such as table of contents and numbering of pages in the notebooks
- Rubrics with clear criteria both inside the notebooks and on the wall
- Dated entries showing evidence of student learning in a variety of forms such as notes, reflections, summaries, data collection, conclusions, etc., about investigations, outside readings, videos or other activities
- Entries provide evidence of implementation of the science module curriculum
- Feedback from the teacher including conference or feedback notes that assess and build on students' notebooks
- Evidence of students' self-monitoring and evaluation of their own learning
- Evidence of differentiated instruction to meet the needs of diverse students
- Strategies that scaffold students' progression to high level critical thinking skills
- Evidence of students' background and experiences being used to support and increase their learning of content
- Essential questions to guide student thinking through the course
- Reflections, notes to self, thinking logs, or other strategies show evidence of student voice
- Evidence of planning for projects and investigations
- Evidence of an established routine that provides students with adequate time to use the notebook during class time

Notebook Writing Strategies to Jump Start Learning

- Quick Write
- ABCD of Scientific Diagrams
- Line of Learning
- Sentence Starters
- KWL/KWLH/TQHL
- Box and T
- Writing Prompts and Frames
- 3-2-1 Countdown
- Claim, Evidence and Reason Statement

Science Notebook Writing Strategies
…increase understanding of science concepts and processes
…plus improve writing skills



Quick Write

Purpose: Formative Assessment
Engage Prior Knowledge
Reveal Misconceptions
Address Changes in Conceptual Understandings

Writing Forms Supported

Summary
Explanation

A ***Quick Write*** is a short (sometimes timed) written response to a specific prompt. The prompt should be designed to address a main concept, standard, or the big idea of the investigation. Often teachers will have the student write their response on an index card at bell time, collect the cards for formative assessment, and then return the card to the student. The student then pastes or tapes the card in their notebook. The quick write strategy can serve as a formative assessment tool and a means to provide a vehicle for the students' self reflections on their own learning.

When using the strategy effectively, teachers will then have the student refer back to their initial ideas in the first quick write when writing another second quick write on the same prompt at the end of the investigations. Then both the student and the teacher can note the changes in ideas occurring as a result of investigating the phenomena.

ABCD of Scientific Diagrams

The ***ABCD of Scientific Diagrams*** is a strategy used to help students identify and remember the critical attributes of a scientific drawing or diagram.

A Accurate labels

B Big

C Colorful

D Detailed

Line of Learning

The ***Line of Learning*** Strategy allows students to add to their written ideas with additional thoughts from other students or the teacher. This strategy is most useful during class discussions when students are sharing out ideas regarding the investigation. Brainstorming lists of possible variables to test, characteristics of objects, using KWL chart, or sharing observations are just a few examples of when a line of learning is useful.

- After writing in their notebooks, students put a line under their personal ideas in their notebooks. Afterwards, the teacher has students share these ideas and adds them to a class chart. Students add new ideas not on their list under the line of learning.
- The line of learning gives the learner the opportunity to continue to construct a concept through the discussion and ideas of other students. It is one step towards creating more sharing among students regarding science ideas.
- The teacher can also use the line of learning as a formative assessment tool to determine where one student's ideas stopped and ideas stopped and ideas from the class were added.

_____ (Line of Learning)

*Notes that student did not already have recorded are added from class discussion.

Notebook Sentence Starters

Using a ***sentence starter*** supports the student's writing as well as provides a focus for their ideas. It narrows the topic for the student.

At first I thought _____, but now I know _____.

One thing I will remember about today's lesson is _____.

I'm certain about_____ but I am uncertain about _____.

The new learning I feel I really understand _____.

The part of solving the problem in today's investigation that was challenging to me was _____.

Some ideas I have squared away are_____.
Three main points I learned today are _____.
One thing I have circling around is _____.

The BIG IDEAS I gained from the investigation were_____.

I still wonder _____.

When I started the investigation I knew _____and now I also have learned _____.

Something I haven't understood before that I understand now is_____.

Next, I would like to explore _____ because I wonder _____.

I am amazed/puzzled by _____.

These results make me think _____ will happen next because _____.

K-W-L, K-W-L-H or the TQHL Technique

The **K-W-L, K-W-L-H** or **TQHL** strategy is commonly used by teachers to help students activate prior knowledge and recognize the change in their ideas due to reading, research, or investigation. Developed by Donna Ogle (1986) to encourage active thinking during reading, it also is an effective strategy in science inquiry.

K – Stands for what the students **know** about the subject
W – Stands for what the students **want** to learn
L – Stands for what the students **learn** as they investigate
H – **How** can they learn more? What are our sources of information?

T – Stands for what I **think** I know
Q – Stands for what **questions** I have
H – Stands for **how** can I find the answer
L – Stands for what I **learned**

Students can use a graphic organizer or create their own their notebook to record their ideas individually before joining in the group sharing of ideas for a class chart.

K-W-L

What I Know	What I Want to Learn	What I Have Learned

K-W-L-H

What I Know	What I Want to Know	What I Learn as I Investigate	How Can I Learn More

TQHL

What I Think I Know	What Questions I Have	How Can I Find the Answer	What I Learned

The Box and T Chart

Using a graphic organizer, ***the Box and T***, to organize ideas allows students to find similarities and differences between objects, living organisms, systems, or processes. Research indicates that one difference between experts and novices may be the ability to see details. This strategy differs from the Venn diagram in that the student first writes the similarities and then moves onto identifying differences.

1. Have students draw a large box in their notebooks. Put the systems or objects to be compared at the top as the title.

Compare and Contrast North and Nankoweap Canyons

Similarities

Students list the similarities in this box. This strategy helps students work on one task of compare and contrast at a time. Here they are simply working on organizing what is the same about the objects.

2. Under the Similarities Box have students draw a T-chart. Title the T-chart *Differences* and put the names of the systems or objects you are comparing at the top. Statements written in the T-chart should be parallel. See examples below.

Differences

North Canyon	Nankoweap Canyon
• elevation of 2800' *• has limestone layer*	*• elevation of 2925'* *• does not have limestone layer*

Writing Prompts

Prompts give specific direction to the student's writing response. Prompts are valuable tools for guiding the student's written reflection regarding new learning so progress towards standards is revealed.

Examples of Prompts

Inquiry

Create a simple model to represent… (common objects, events, systems or processes).

Systems

Compare the parts of… (a model) to the parts of… (a real system).

Application in Solving Human Problems

Describe the reasons for the effectiveness of… (a solution or challenge).

Writing Frame

Writing frames provide a *scaffold skeleton* that assist students in expressing their understanding. Writing frames are different from cloze paragraphs where students fill in the blank with specific words. The writing frame focuses the response but still allows for individual student answers.

Nankoweap Canyon and North Canyon are surprisingly alike.

They both _____

and _____.

*Therefore, each of the canyons*_____

Also, North Canyon is like Nankoweap Canyon because they both

_____.

My evidence is _____.

On the other hand North Canyon has several differences from

*Nankoweap. First, North Canyon is*_____

because _____.

*However, Nankoweap Canyon is*_____

because _____.

*Another difference is*_____

because _____.

So from my observation of North and Nankoweap Canyons I learned

_____.

3-2-1 Countdown

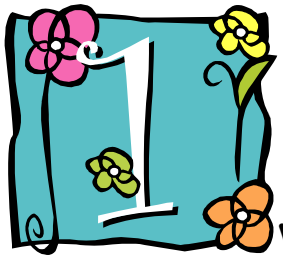
Using ***3-2-1 Countdown*** allows for individual student self analysis.

- **3** – What are THREE things you learned?
- **2** – What are TWO things you still wonder?
- **1** – What is ONE thing that surprised you?

3-2-1 Countdown

What are THREE things you learned?

What are TWO things you still wonder?



What is ONE thing that surprised you?

Claim, Evidence and Reasoning Statement

- **Claim:** statement or conclusion about a problem or question
- **Evidence:** scientific data that supports the claim
- **Reasoning:** justification that links the claim and the evidence together, showing why the data count as evidence to support the claim by using the appropriate scientific ideas or principals

Model and Practice Scientific Explanation

- Model the behaviors of a scientist and model how to analyze the data using the framework
- Create opportunities for students to practice via the daily sponge by providing relevant practice data sets for students to analyze, make a claim and support with evidence OR by providing a claim and evidence statement and students describe the data set that the evidence would require
- Make connections between everyday discourse and science discourse

Claim-Evidence-Reasoning Statement

Focus Question

CLAIM: A statement that answers the original focus question or problem.
What conclusion can you make about your original focus question or problem?

EVIDENCE: Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.
What data or observations do you have to support your claim?

REASONING: A justification that links the claim and evidence and includes appropriate and sufficient scientific principles to defend the claim and evidence.
How does the data you used for evidence support your claim?

Claim-Evidence-Reasoning Statement

An Example from Chemical Interactions
Following Investigation 3

Focus Question

Does air always take up the same amount of space?

CLAIM: A statement that answers the original focus question or problem.
What conclusion can you make about your original focus question or problem?

Air does not always take up the same amount of space. Air can be compressed into a smaller space or can expand into a larger space. .

EVIDENCE: Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.
What data or observations do you have to support your claim?

When our group trapped air in a syringe with a clamp we could press down on the plunger to make the amount of space that the air took up smaller. We were also able to pull the plunger back up to allow the air to take up more space.

REASONING: A justification that links the claim and evidence and includes appropriate and sufficient scientific principles to defend the claim and evidence.
How does the data you used for evidence support your claim?

The air in the syringe is made of particles that have nothing in between them. Since the air is trapped in the syringe the number of particles stays the same and can't change. The space between the air particles gets closer together when the plunger compresses the air. When the plunger is pulled out, the space between the air particles increases and the space the air takes up expands.

Claim, Reasoning and Evidence Statement Rubric

Component	Level		
	0	1	2
Claim – statement or conclusion that answers the original question/problem.	Does not make a claim, or makes an inaccurate claim.	Makes an accurate but incomplete claim.	Makes an accurate and complete claim.
Evidence – scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.	Does not provide evidence, or only provides inappropriate evidence (Evidence that does not support the claim.).	Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support claim.
Reasoning – justification that links the claim and evidence and includes appropriate and sufficient scientific principals to defend the claim and evidence.	Does not provide reasoning, or only provides recording that does not link evidence to claim.	Repeats evidence and links it to some scientific principles, but not sufficient.	Provides accurate and complete reasoning that links evidence to claim. Includes appropriate and sufficient scientific principles.

Alpha Boxes

Alpha boxes are an organizational tool for students to record and retrieve new science vocabulary. It is different from a typical glossary in that it does not include a textbook definition. Rather students record each new term and the page number in their science notebook where the word is defined within their work and in their own words.

- Introduction of term ***after*** students have an investigative experience to "hang it on."
- Located at end of notebook, alpha order by letter, page number in notebook.
- Notebook entry (on designated page number) includes definition in students' own words, visuals, graphic organizers, contextual sentences.