

## Active Learning With Science Notebooking: Engaging the Brain

With the reality of a mandatory fifth grade nationwide science assessment pounding at my door, I knew I needed to make some changes in my science instruction. I enjoy science. I taught science. I just was not teaching it the way the national standards called for me to teach. This was obvious to me the first time I looked at a fifth grade state released item. I realized that, YIKES, there was a big hole in what I was doing and the science was leaking out of it. I needed to be intentional in my instruction, letting go of some things that were not helping students hit specific targets of learning. Shooting just to shoot is a lot different than aiming at a target while shooting. I finally saw the target and took aim.

Have you ever used a science log just because someone told you it was the thing to do? In the past I have asked students to bring several spiral notebooks to school in September; one for writing, one for math, one for spelling, one for reading, and one for science. Subjects were isolated, and that message was sent to the students through the use of separate logs. I guesstimate I gave students the occasion to use their science log ten times or less during the year. Those pages were filled with such things as sketches and names of plants at our school wetland site, notations of animals we saw there, and things we could sense. Students were asked to take notes in the log for a question and answer period after oral reports their fellow students had given on astronomy. Logs were pulled out to take notes when a guest speaker came to talk about what a watershed was. These were all simple tasks, low on the taxonomy of learning.

Thinking back, I remember students asking permission to use their science log for writing because they had used up all the pages of their original log. “Mrs. Lundberg, will we be using our science log anymore this year? I need a new writing log. Can I use my science log?” I did keep an extra supply of spiral notebooks for this type of emergency, but occasionally I caught students tearing out their science work without asking. They planned to use it as a second writing log, assuming the science log was not needed. They were not far from the truth. I was not using the science log effectively.

Obviously, somehow the false impression that writing in science was not as important as the activity crept into my schema. Often times, I would teach a science lesson and run out of time. The next science lesson may not come for several days, and then I would just move on to the following activity. Big mistake! This type of teaching leaves large gaps in student learning. Verbal comprehension checks are not enough since only a few students respond in a whole class discussion. This practice also leaves out visual learners who need to write or draw to understand.

No Child Left Behind was the catalyst that morphed my science logs of yesteryear into laboratory notebooks – Notebooks that incorporate experiments, vocabulary, recording of data, and teaching of specific science skills. I am much more intentional with instruction. I explain to students that they are scientists, and a scientist always

documents evidence to provide valid data to prove or disprove a hypothesis. Most importantly, scientists must repeat experiments to validate data. Scientists record data in order to repeat and compare.

### Intentional Instruction for Science Notebooks

An inquiry based unit on force and motion presented the perfect opportunity for me to have my students use science notebooks. I grabbed some 8.5 in. by 11 in. grid paper, folded it in half, placed some blue construction paper around the outside, stapled the middle, and we were ready to go. I had my new tool for students to understand the scientific process.

The challenge was presented. Students must build a chassis that travels in a straight line. The first log activity was the introduction of the vocabulary word, **procedure**. Students recorded the procedure of the investigation. Quin's log reads: Build chassis; build 30 degree ramp; test chassis on ramp; make adjustments until the chassis travels straight; repeat straight line movement three times.

For the next entry, students were introduced to the vocabulary word, **materials**. I then had students list the materials needed. Quin wrote: Straw (bearing); chassis pattern, tape, axle (straw); wheels; scissors; measuring tape; pen; angle ruler; ramp; yarn.

Before trails began, students wrote a **prediction** about what to do to insure their group's chassis would travel in a straight line. Dana predicted: I think the chassis goes straight because the bearing and the wheels are straight. If they were slanted, the chassis wouldn't go straight.

Trail data was recorded in the journal. Dana's log reads:

Trail #1

The chassis didn't move straight because the axle was crooked.

Trial #2

The chassis curved slightly to the right. The axle was still crooked.

Trial #3

The chassis still moved to the right. The axle was still slightly crooked.

Trial #4

Chassis moved straight. The axle was straight.

Next, students wrote **conclusions** based on the trials. Dana writes: Human error can make (the) chassis turn. If the bearing is cut too short, the axle can shift and cause the chassis to turn. The car goes straight because the wheels are evenly lined up. The wheels are like a steering wheel in a way and direct the car. If the sides of the chassis are turned outward, they can rub against the wheel and cause the wheels to turn and slow down the chassis.

Comparing what was written in my science logs of the past to the science journals I use today, presents an obvious conclusion -- intentional instruction using a science notebook is a far superior learning tool.

### Getting Started

Start out by posing a problem to the students that they will need to find the answer to. This develops into a question. Next, as a class, have the group define the question. They must understand the question in order to find an answer. At the elementary level, questions are most likely on systematic observations. Once a question is agreed upon, students write it in their notebook.

Next step, students conduct an investigation to answer the question. At this point, if your students have not been exposed to a controlled experiment, you can use science notebooking to teach the process to them. Have students write down the steps to the investigation. This does take time. Explain to the students that today you are learning about the scientific process, tomorrow you will conduct the experiment. As students become familiar with the process, this takes less and less time.

Or, you can decide that the students want to get on with today's experiment and use the science notebook to focus on part of the investigation as I did with the force and motion unit above. It would be difficult to have elementary students copy every part of the investigation; however, you can use this tool to instruct for understanding the part of the investigative process you choose to emphasize.

Look to the standards on investigating systems in order to use notebooking to develop the knowledge and skills necessary to do meaningful scientific inquiry. The list below is straight out of the National Science Education Standards available through National Academy Press. Sources like this give teachers a wealth of direction in using notebooking effectively while hitting the science standard targets.

### Notebooking Possibilities

- Access students' prior knowledge – Ask them to write about what they already know
- Teach students how to record data and integrate math in an organized manner
- Teach vocabulary in the context of the investigation
- Question is clearly understood and written
- Prediction
- Students report observations or data of simple investigations without making inferences
- Repeat trials and record data
- A written answer to the question or an explanation as to why it cannot be found

- Generate a scientific conclusion, including supporting data from an investigation
- After a whole group discussion, allow students to write in the science notebooks about what they further learned after the whole class input
- Reflection on their prediction
- At the end of the unit, have students write about how they can apply what they now know
- List appropriate materials, including tools as well as technology
- Noting of variables kept the same (controlled)
- Noting of one changed variable (manipulated)
- Noting of measured or responding variable – Ask students to define what observable or measurable variable related to the investigative question
- How to gather, record, and organize data using appropriate units, charts, and/or graphs
- Further research through other sources such as the Internet
- Predict what logically might occur if an investigation lasted longer or was changed
- Summarize an investigation by describing reasons for selecting the investigative plan
- Use data from science notebooking to create a final product for presentation.

### Teacher's Role in Science Notebooking

As students are investigating and writing, ask guiding questions to help them achieve deeper understanding. Collect the student notebooks and read them to check for understanding. Write feedback to students in the notebook. Let them know what they are doing right. Compliment them. Ask them to fix something. Ask them to get some information from their learning group or partner if they neglected to include it in their log. If you do not want to write directly in their log, write on sticky notes. Some students treasure these notes and save them on the inside cover of the back of their notebook.

Deeper questions that are generated during class discussion can be used as enrichment and differentiating in the classroom. Have students save the last few pages of their notebook to write such questions and refer to these questions if time allows for further research. Groups finish investigations at different times. The early birds can take things deeper by finding answers to these probing questions and create a PowerPoint presentation for the class.

Teachers, remember the notebooks are like a scientist's rough draft. They are handwritten, and not always perfect. However, they are powerful tools of learning that demonstrate understanding and apply what science is all about. Science notebooking is an effective tool for authentic assessment, integration of math, and hitting learning standards that will strongly prepare students for success on the mandatory yearly science assessment.

Be familiar with your school's past science scores. Take the time to notice patterns in your student's daily learning by noticing strengths and weaknesses. Let these patterns drive instruction and target the areas you think will have the greatest impact for improvement in student learning and understanding. Next, hit these areas hard using notebooking as a venue of instruction.

The good news is notebooking along with a fifth grade science fair that incorporated the use of science notebooks, have made a big difference for our school. Not only have teachers witnessed students with a deeper understanding of scientific investigation, the understanding carried over to our state science assessment. Everett School District's average for students meeting standard on our state's science assessment is 43%. The state average is 36%. Eighty-two percent of the students at Cedar Wood Elementary School met standard on the 2005 science assessment. I think I'll stick with science notebooking.

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