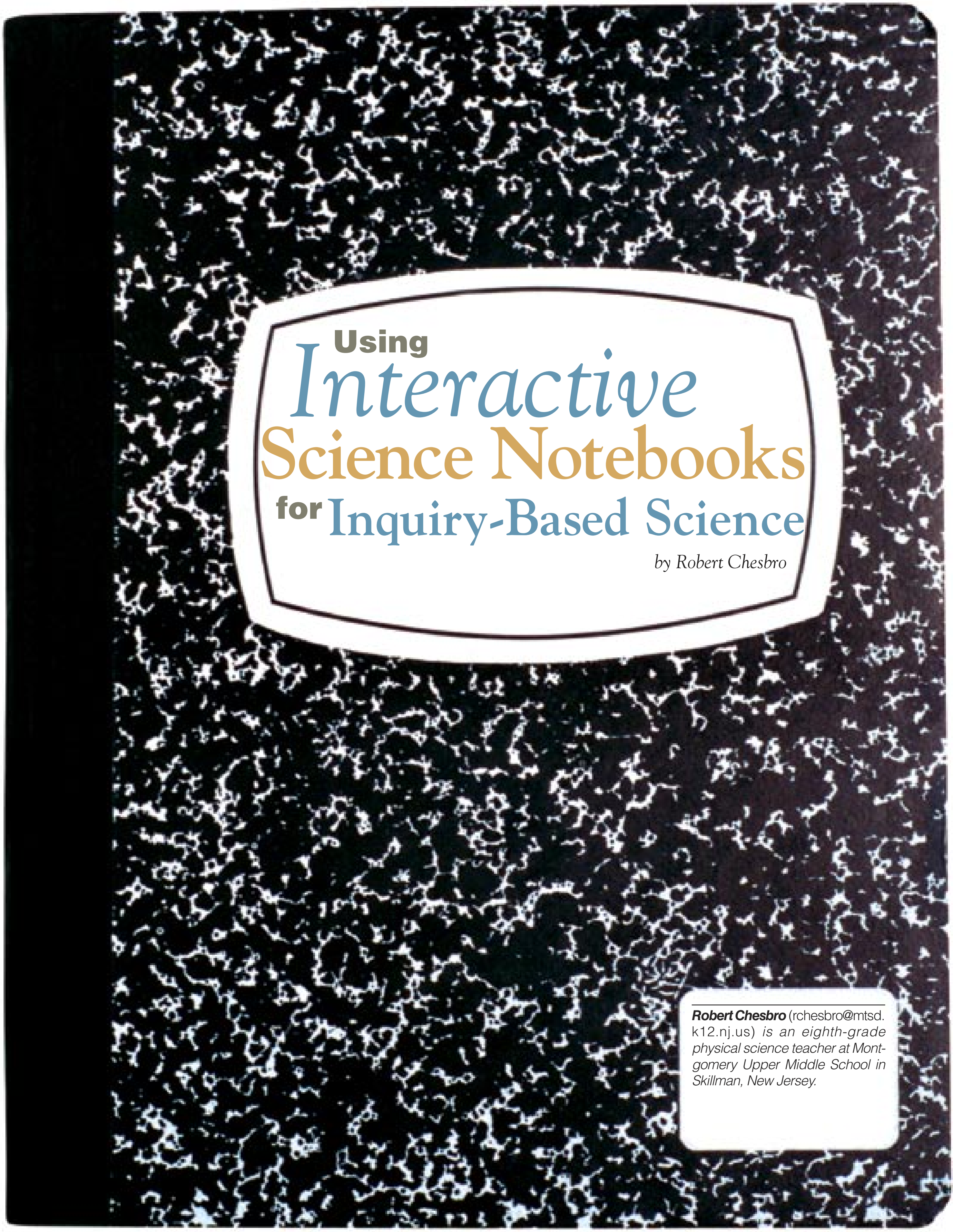


Using Interactive Science Notebooks for Inquiry-Based Science

by Robert Chesbro

Robert Chesbro (rchesbro@mtsd.k12.nj.us) *is an eighth-grade physical science teacher at Montgomery Upper Middle School in Skillman, New Jersey.*

Educators know that there is nothing so personally and professionally degrading than the sight of the garbage cans overflowing with discarded student work on the last day of school. I have often asked myself whether we are doing all we can as professional educators to ensure that our students get the most of their education. A garbage can full of tangible examples of student learning seems to do nothing but suggest otherwise.

In my first six years of teaching middle school science I often asked myself questions such as, What exactly do my students remember from my science class? How can I get my students to be better learners in general? How can I get students to see the inherent link between emotion, personal connections, and learning? How can I better differentiate assignments to meet the unique developmental needs of a wider base of my middle school science students? How can I get away with using less paper? The answer to my questions came at the beginning of my seventh year when I was introduced to Jocelyn Young's publication Science Interactive Notebooks in the Classroom (Young 2003). I interpreted her methodology and tailored the notebook concept and setup to my own teaching style and the inquiry-based Carolina *Science and Technology Concepts for Middle Schools* (NSRC 2000) modules used by my district. These modules emphasize the process of focusing, exploring, reflecting, and then applying as a systematic means of students conducting inquiry-based learning, and the interactive science notebook is an excellent way of promoting that model.

Using interactive science notebooks in the classroom

The interactive science notebook (ISN) is a perfect opportunity for science educators to encapsulate and promote the most cutting-edge constructivist teaching strategies while simultaneously addressing standards, differentiation of instruction, literacy development, and maintenance of an organized notebook as laboratory and field scientists do. Students then have a packaged notebook representing all of their learning throughout the year.

The notebook used in my eighth-grade classroom is a bound 200-page composition journal that students purchase at the beginning of the school year. (They also buy separate notebooks for the chemistry and physics portions of the school year.) The notebook is small enough to fit in the pocket of a three-ring binder, and is therefore less likely to be lost or misplaced. More so, it remains essentially intact, whereas spiral-bound notebooks typically become inaccessible once the spirals are crushed or unraveled. I've found that the notebooks with plastic covers are the most durable and tend not to come apart as easily as the cardboard ones. Students are asked to bring in a roll of clear tape during the first week of school, and this tends to be enough to use in the classroom throughout the school year. The tape is placed in a plastic box on their classroom tables along with the colored markers, pencils, and sticky notes that I provide. I discourage the use of glue because it can make the pages stick together. Total cost for one box of supplies for a group of four runs on the order of $12–$15. Having the box in such an accessible place for students allows them to efficiently fold and tape any handouts to the appropriate notebook pages.

When setting up the notebook, students are required to label and date each page based on the assignment or lesson. Handouts can be cut and taped to pages, or taped so they flip up as pages of a clipboard notebook might. The first page of the notebook is skipped and is used by me to indicate scores for notebook assessments. At the end of the year a student generates a condensed foldout table of contents to be taped to that front page. Students cut and tape an assessment rubric (see Figure 1) to the inside cover of the notebook for quick and easy reference for both the student and teacher. The rubric is used for assessments throughout the year, and each point is assessed with a different color marker to show trends in performance from one notebook check to another. I collect the notebooks at the end of each marking period for a 60-point score, and then again as a finished product for a 120-point score. Minor notebook checks along the way may span a few pages and amount to 10-point grades.

The ISN is broken down into a right-side and left-side page technique in which students create "input" on the right-side pages (lecture notes, lab data, reading notes, etc.) and then process that input in a meaningful and personalized manner on the left-side pages in the form of "output"(Young 2003). Left-side output ranges from the creative arrangement of input information into predesigned or original graphic organizers for visual and spatially adept students (see examples of student output) to acrostics and the 3-2-1 Review, or other countless written summary exercises for language-oriented students. For an acrostic exercise students are encouraged to write a statement about the content of study that starts with the first letter of a word or statement (i.e., if the phrase were "Atoms are tiny," then a student might start with "atoms are the building blocks of matter and are indivisible"). Students are encouraged to use online abbreviations (lol, omg, ttyl, etc.), as well as Yoda talk (backwards), as long as the statement is scientifically accurate. For a 3-2-1 Review, I might ask students to "list three things you learned, two things you wonder, and one symbol that captures the essence of the topic of study" (density, solubility, the metric system, etc.). Another strategy to the 3-2-1 Review approach is to ask students to invent and respond to their own categories.

In essence, any summary activity that promotes higher-order thinking can be considered an output activity, and students are also free to invent their own form of output with teacher approval. Figure 2 is the document my students receive at the beginning of the year that shows the difference between the right side and the left side, and shows possible output activities, including a graphic organizer link from which students may print graphic organizer templates.

Figure 3 shows an example of graphically organized input notes on the right-side page on the topic of Atomic Theory Development. Students then generate a Top 10 List for homework output. The output shows personalization of the information read about in class.

Once an inquiry has been completed, students are asked to write a paragraph explaining both the results and possible flaws in the experiment, and then to invent and explain a symbol that represents a relevant concept (Figure 4). Labs are kept in the notebook, with data on the pages or accompanying handouts. All student work is kept in chronological order. With the online version of this article you will find examples of

- input data collected by students for an inquiry investigating the solubility of various substances;
- a teacher-generated graphic template that guides students to create output by interpreting the graph and then placing various personalized touches in the additional bubbles;
- a student-generated graphic of output for the topic of States of Matter and Their Characteristics; and
- a double-sided inquiry handout used as input that contains introductory concepts, a student-generated procedure, and all lab data.

FIGURE 1 **Assessment rubric**

Category	10—Poorly done and fragmented	15—Needs improvement	24—Proficient	30—Advanced proficient
Left side: Personal connections	• Does not yet meet proper requirements • Blank pages Red Alert!	• Some processing and personalization • Personalization should be much deeper or more related to concepts • Personalization hard to understand	• Shows basic processing of info • Shows basic personalization of learning • Shows basic personal connections • Personal connections a little hard to understand	• Shows in-depth processing of info • Shows deep personal connections to learning concepts • YOU come through in the personalization!
Category	8—Poorly done and fragmented	12—Needs improvement	16—Proficient	20—Advanced proficient
Right side: Detail of input	• Does not yet show proper requirements • Blank pages Red Alert!	• Right side somewhat detailed • Care and attention to concepts shown with frequent gaps • Some improvement still needed in presentation of data and tables	• Right side fairly detailed • Shows some care and attention with minor gaps • Minor improvement needed in presentation of data and tables	• Right side very detailed • Shows care and attention to concepts • Data are clearly set up in properly constructed data tables
Category	4—Poorly done and fragmented	6—Needs improvement	8—Proficient	10—Advanced proficient
ISN standards: Page numbers, dates, proper placement of work, neatness	Many errors or omissions in the standards (8 or more)	A few errors or omissions in the standards (4–7)	Only minor errors or omissions in the standards (1–3)	• All pages are numbered and dated • All items are taped in their proper place • Work is neat, organized, and legible

FIGURE 2 **Student handout detailing input and output**

Left side—Output	Right side—Input
This is where you personally connect with the information on the attached right side page	This is where you put incoming information: notes, data, and so on.
On the left side you will: Date, label, and number each page Do output exercises, such as: • Summary techniques • Word splat • Alphabet review • CD label • 321 reviews • The thing about… • First letter first word (acrostic) • One word/one image summaries • Synectics • Graphic organizers • Tables/Graphs • Flow charts • Word webs • Mind maps • Concept maps • Diagrams • Venn diagrams • Creative stuff • Pictures/Drawings • Brainstorming/Brain dumps • Poems/Limericks/Raps/Quotes/Songs/Cartoons • Weird and bizarre thoughts/ideas/images • Outcome sentences • I learned… • I am surprised… • I wonder… • I now understand… • I rediscovered… • I like… • I don't like… • The important thing about…	**On the right side you will:** Date, label, and number each page Write down information from: • lectures • readings • presentations • videos • labs **Resource note**: For online graphic organizers try *www.eduplace.com/graphicorganizer.* Print them out and tape them in.

One particularly popular form of output that my students enjoy is the CD label. Students read information or collect class notes as input and then create a CD label reflecting what they've learned, inventing the name of a band, album title, and track titles based on the topic.

Whatever the form of output, students are required to show that they "get" the content of the lab or assignment in a way that works for them. This allows students to make deep and resonating connections and allows me to get to know them through their writing when I assess their notebook. I recommend that teachers consistently model student work that accurately shows personalization of content.

Assessing the ISN

Assessment should vary depending on the style of the teacher. My approach comes in two forms and the rubric is used for both (Figure 1). Although there is no single way to assess the notebook, it is essential that teachers assess and provide feedback on a regular basis. The first mode of assessment is the periodic notebook check mentioned earlier, in which I will briefly check notebooks in class or collect a class set of notebooks overnight. The periodic notebook check is designed to offer consistent feedback to ensure that students are keeping a tidy notebook with dates and labels, organized notes, and in-depth personalization.

FIGURE 3 **Student input and output on the topic Development of the Atomic Theory**

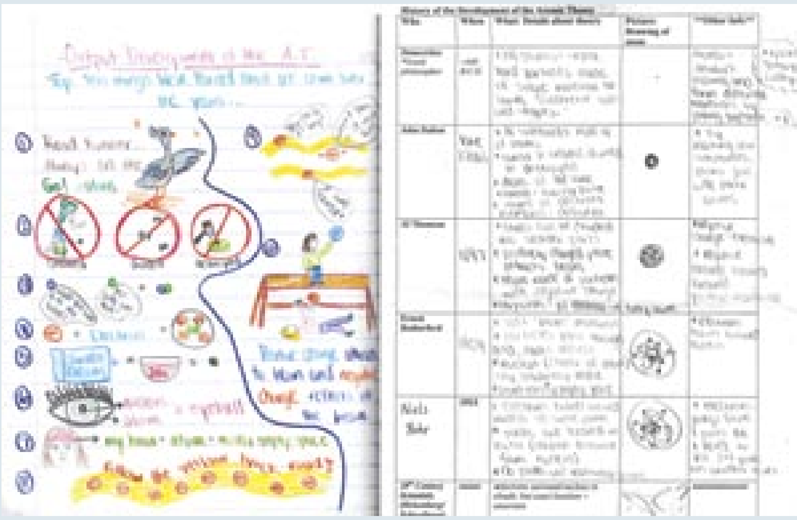
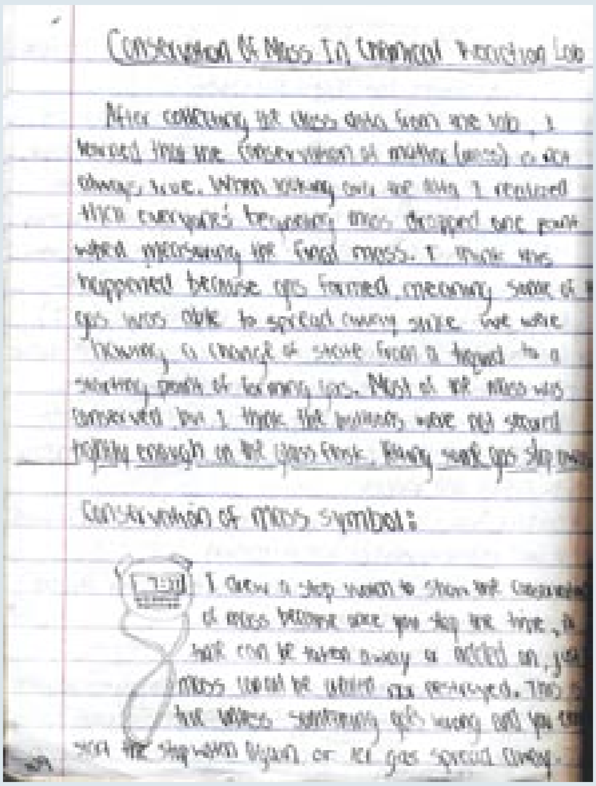


FIGURE 4 **Student output following Conservation of Mass in Chemical Reactions inquiry**



The second mode of assessment is a more holistic student self-evaluation used at the end of the year. Students evaluate and explain the effectiveness of the ISN as a valid learning tool based on their own notebooks; the final score must then be approved by me. Scores typically fall very close to the score I would assign. For those teachers hesitant to allow self reflection in their classroom, don't worry. Students are typically very honest critics of themselves, and they are the only ones who know the degree to which the ISN has worked for them.

There are the occasional students who neglect the interactive notebook, usually due to laziness. These students receive the consequent low grades on the notebook checks and are encouraged to stay after school with a student to help get caught up; the notebook is a useful indication to the parents of unmotivated students as it shows the degree to which the student is not performing compared to another student's notebook. Students who struggle with the notebook are offered copies of class notes and an ongoing table of contents. The notebook amounts to about 15–20% of the marking period grade. One particularly tricky issue is what to do when students lose a notebook. I ask students to label the cover "If lost, please return to Mr. Chesbro's room: E104" to avoid disaster, but this is not foolproof. Students who do lose theirs are asked to start a new notebook. I have to gauge an appropriate consequence for the student depending on the scenario surrounding the loss.

Conclusion

True to the nature of the ISN, teachers should practice what they preach and personalize ways in which they implement the ISN as a learning tool in their classrooms, and should treat the recommendations stated here as merely one teacher's approach to a multifaceted classroom tool. I cannot stress enough how important it is that teachers adapt the ISN to their own teaching styles and elicit student feedback along the way. Regardless of the form it takes in the classroom, the ISN is an extremely effective constructivist innovation in enhancing general learning through the encouragement of writing across the curriculum, personalization, and metacognition strategies, while simultaneously serving to promote more specific inquiry-based science instruction by which students focus, experiment, reflect, and apply based on their personal connections to learning. ■

References

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