Science Notebooks:
Teacher Support

Science Notebooks are a method of actively engaging students with content and experiences in the science classroom. They are an important functional tool for teachers, but also have longer-lasting impacts on the impression students develop about science. Science Notebooks can be used to bring a creative, personal element to science inquiry, encourage student investment in their scientific learning, and help students fall in love with the field of science. Notebooking allows students to practice key skills needed to develop into well-rounded, educated citizens, such as literacy, organization, self-expression, and persistence. This guide is intended to broaden perspectives on how Science Notebooks can be used to enhance the learning experience, as well as give practical advice for how to incorporate Science Notebooks in the *Inspire Science* classroom.

Science Notebooks are versatile and personalized. They can be used with students of all ages, language levels, and learning abilities, perhaps especially with English Learners (ELs). Teachers can use notebooking in a way that is unique for their particular group of students, or adapt the uses to support differentiated instruction. Science Notebooks include much more than simply taking notes in class. Students may use their Science Notebooks to record observations from class discussions, demonstrations, or experiments. They may use them to record and explore questions, or to include tangible elements from class experiences. They may write summaries or reflections and create glossaries, make vocabulary lists, or draw pictures. The many uses of Science Notebooks are confined only by the creativity of those using them.

How can Science Notebooks enhance the learning experience?

- Literacy skills
- Creativity
- *Foldables*®
- Reference and Study Guides
- Integrating the Three Dimensions

No matter the age group or situation, Science Notebooks offer many different avenues for enhancing the learning experience in the science classroom. Five of these aspects will be explored in detail in this section. Science Notebooks allow students to practice their literacy skills while engaging with science-based inquiry, they give students space to apply creative autonomy to their learning, they encourage interactive engagement through *Foldables*® and other realia, they function as a reference and study guide before assessments, and, finally, they allow students to practice integrating the three dimensions of science, such as those outlined in the Next Generation Science Standards (NGSS) (NRC, 2012).

Literacy Skills

Language literacy is a key component of scientific competence. Students of all ages are expected to read scientific texts in order to understand new concepts. Likewise, writing is critical for sharing the understanding of this knowledge, for both students and scientists in the work force. Science Notebooks play an integral part in the promotion of literacy in the science classroom by acting as a support mechanism for reading or listening and as an avenue of expression for recording thoughts, data, analyses, and scientific explanations of phenomenon.

Note-taking

The note-taking component of notebooking serves many purposes. It allows space for students to keep track of what they have learned and questions they may still have. Note-taking is not only an important skill, but also a very meaningful way to interact with information that is being taught. It forces students to focus on, digest, and make sense of content by actively using three of the four language domains: listening, writing, and reading. Depending on the age and level of students, there are several specific settings where students could be taking notes, such as during direction instruction, independent reading, and collaborative activities.

Helpful Tip

Reassure students that they do not have to write everything you say, word-for-word. They could even utilize their own short hand.

Direct Instruction. Some classroom experiences, especially for older students, include direct instruction in the form of lectures or videos. There are many note-taking techniques that help students internalize this content. One of the more popular methods is the Cornell Notes system. In this technique, students divide their paper into two columns (one small and one large) and leave a few lines at the bottom. During instruction, students take general notes within the larger column, and in the smaller column, they write big ideas, questions, comments, and keywords. After instruction, students use the lines at the bottom of the page to write out a summary of what they learned. No matter which specific note-taking method is chosen, Science Notebooks provide a space where these notes can live within the context of other material, such as manipulatives, observations during experiments, and reference materials.

Independent Reading. Highlighting and underlining is usually not sufficient for helping students comprehend the text assigned for independent reading. Students can get bogged down by trying to take notes while reading, so an alternative could be taking notes from memory. After reading the text, encourage students to write down any terms, definitions, or ideas that they remember in their Science Notebook. Students could also use this space to record questions about the text that they need to have clarified.

Collaborative Activities. An interactive science classroom also includes many hands-on activities such as digital interactives, inquiry activities, STEM projects, and research that may be enhanced by active note-taking on things students learn, things they still have questions about, or ideas they may have generated.

When used effectively, notes within Science Notebooks are tools for students to use as they study or to reference back to as they move through the course and learn concepts that build on each other.

Helpful Tip

Encourage students to include detailed information at the top of their page indicating which activity they are responding to.

Reflective Writing

In addition to note-taking during activities, Science Notebooks serve as a repository where students can share reflections, predictions, or reactions in the form of journal responses. This allows students to practice their writing skills in a low-stress environment, while still engaging with the scientific content. The strict rules of grammar and structure are more relaxed in this environment, which lets students write freely without inhibition. Using Science Notebooks in this way also communicates to the teacher, without the stress of a formal assessment, how well students are grasping the scientific concepts.

Building Vocabulary

In order to succeed in science, students must develop an understanding of academic and discipline-specific vocabulary. In a simple sense, Science Notebooks are an excellent medium for keeping track of new vocabulary and can be a useful reference during activities or class discussions. However, Science Notebooks should not be limited to the role of a dictionary. By incorporating vocabulary in diagrams, manipulatives, data, descriptions, and journal entries, students can begin developing a more comprehensive understanding, not just of definitions, but also of how words are used in context and for a specific purpose. The vocabulary will become, then, a means of expressing meaning, rather than a list of terms to memorize. Science Notebooks provide space for students to practice using the scientific language in an authentic and meaningful way – to communicate to themselves, the teacher, or classmates.

Helpful Tip

Foldables® provide a fun, interactive way for students to engage with vocabulary. See the *Foldables* Handbook for tips on how to use these in your classroom.

Creativity

Many students learn best by engaging their creative brain. After reviewing and reflecting on their notes, students can then inject this knowledge into a creative outlet such as writing a poem or song, drawing, or even mind mapping their thoughts. This interactive component of Science Notebooks encourages students to be creative and gives them ownership of their learning.

Encouraging Creativity

Students should feel empowered to enliven their notebooks with creativity. Science Notebooks should not simply be pages of written notes, but should include a variety of content and manipulatives.

Teachers may choose to have students:

- write guiding questions for activities
- create a chart to represent concepts discussed
- include graphs depicting data collected during investigations
- sketch images of observed phenomenon
- make lists and step-by-step procedures
- write reflections or predictions about phenomena
- draw diagrams to show their learning

Some materials may be incorporated after creation, such as worksheets, *Foldables*®, vocabulary cards, or other three-dimensional artifacts. As students get more comfortable using Science Notebooks, they should be encouraged to make their own decisions about how to present the information in their Science Notebooks and what to include. This freedom of expression may be new to many students. Teachers may find it helpful to devote specific pages and time for creative work.

Student Ownership of Content

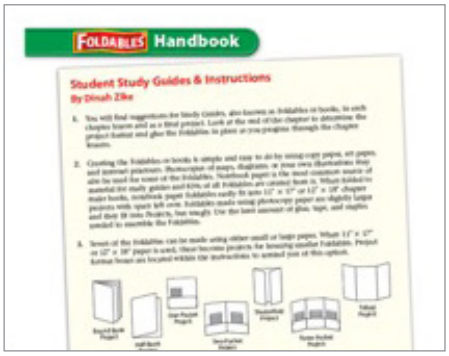
Science Notebooks will become, by their very nature, tattered, stained, and well-worn. Students should be encouraged to decorate, embellish, and design them as they desire. By allowing and promoting this personalization, students are given agency over their own Science Notebook and will begin to develop a feeling of ownership, which may very well expand to include a feeling of belonging in the field of science. Some students may embrace this freedom more than others. Additional support and structure in the form of specific worksheets or handouts, suggestions for what to include, and directions for various sections may be valuable or necessary for some students. As they learn to incorporate creativity in their work, it is important to remind students that Science Notebooks are most useful when they can be read, referred back to, and fit within the confines of a backpack, desk, or locker. For this reason, it is important that they stay organized, neat, and legible.

Helpful Tip

Devote a few minutes of classroom time each day or week to allow students to create and develop their notebooks. Creativity takes time!

Foldables®

***Foldables* are a great way to encourage interactivity within the Science Notebooks.** They are created from paper, cut and folded in intentional ways, and represent scientific concepts or ideas.



The *Foldables*® Handbook and the *Foldables*® Video Library, both included as part of the *Inspire Science* program, include in-depth descriptions of different strategies and tips from the creator of *Foldables* herself, Dinah Zike. *Foldables* can be used independently or incorporated within the Science Notebooks.

When using *Foldables*, consider the following suggestions:

- Assign specific *Foldables* that align to the lesson content, or for a more independent approach, have students choose and develop their own *Foldables*.
- Use anchor tabs to adhere the *Foldables* to the pages to reduce the amount of extra paper and glue in the Science Notebook. Anchor tabs are small folded sections on the side of the *Foldables*.
- Use quarter sheets or half sheets of paper to keep the *Foldables* confined within the space of the Science Notebook.
- Create pockets for smaller *Foldables* by adhering envelopes to the pages of the Science Notebook.

Reference and Study Guides

There are many situations in the classroom where students might be expected to return to previous work. Perhaps they are working on an experiment that builds on previous work they completed. Perhaps they want to look up a definition they forgot in order to use more specific wording in an explanation. Perhaps they want to use data they collected as evidence in a scientific argument. This type of referencing will be inevitable as scientific concepts build on each other and support each other. In addition to providing a repository of their work, Science Notebooks are also a great tool for practicing metacognitive skills and providing authenticity to classroom tasks.

Metacognitive Skills

Metacognition refers to a student's awareness of their own thinking. Science Notebooks provide a concrete record of students' learning for self-reflection. Students are able to see their own growth in scientific thinking over time. They become aware of their own learning processes and begin to evaluate their own work. Continual attention to this self-evaluation will encourage students to record their own thoughts and observations in a way that will be accessible to their future selves.

Authentic Work

When students use their own work as reference material, it gains meaning beyond a simple classroom task, just like the work of scientists, engineers, and researchers. As students refine their notebooking skills, their Science Notebooks will become a valuable source of information on scientific topics. They will be able to refer back to experiments, observations, and discussions to help them understand connected topics. Students will begin to recognize that their own scientific work holds value, placing them as actors in the field of science, rather than just observers. In this way, the Science Notebook allows them to do the authentic work of a scientist or engineer.

Integrating the Three Dimensions of Science

Following the expert guide of *A Framework for K-12 Science Education* (NRC, 2012), many science classrooms have shifted their focus to the three dimensions of scientific study: Disciplinary Core Ideas, Science and Engineering Practices, and Crosscutting Concepts. Disciplinary Core Ideas are the concepts and information of topics, while the Science and Engineering Practices are taken directly from the work of scientists and the Crosscutting Concepts recognize the themes that span all content areas. Educators have come to realize that it is just as important for students to practice doing science in addition to learning about it.

Students engage with the Science and Engineering Practices listed here within their Science Notebooks. They record questions and create and modify models of all kinds. Science Notebooks hold the work of investigating, including the charts, tables, and data needed for analysis and interpretation. Students can use the content collected in Science Notebooks to support scientific arguments. It also functions as a method of communication, in addition to being support during presentations, projects, reports, or other written or oral communication. Science is the act of doing, not just knowing, and these practices were developed to reflect the actions of scientists and engineers in conducting, recording, and communicating their work. The Science Notebook provides evidence that students are also engaging in these authentic practices.

Science and Engineering Practices	Crosscutting Concepts
Asking Questions and Defining Problems	Patterns
Developing and Using Models	Cause and Effect
Planning and Carrying Out Investigations	Scale, Proportion, and Quantity
Analyzing and Interpreting Data	Systems and System Models
Using Mathematics and Computational Thinking	Energy and Matter
Constructing Explanations and Designing Solutions	Structure and Function
Engaging in Argument from Evidence	Stability and Change
Obtaining, Evaluating, and Communicating Information	

National Research Council, 2012

The Crosscutting Concepts encourage students to recognize the patterns and connections between various domains of science. By keeping an organized Science Notebook, students should begin to recognize these repeating themes throughout their scientific work. Students are able to document their expanding knowledge of science, and both teachers and students can see concrete evidence of their growth.

Helpful Tip

If time permits, share real-life science notebooks or journals from local scientists or engineers.

Science Notebooks and *Inspire Science*

Science Notebooks allow teachers and students to personalize the learning experience while using the *Inspire Science* program. Although there are endless ways Science Notebooks can be incorporated in a classroom, as previously described, the *Inspire Science* program encourages teachers to use them for recording Essential Questions, formulating additional questions, making personal connections, expanding labs and other hands-on activities, and collecting research information.

Recording Essential Questions

Each lesson in *Inspire Science* begins with students exploring a scientific phenomenon, which connects to the Essential Question for that lesson. As students engage with the content throughout the lesson, they collect evidence, make observations, and develop reasoning to help them answer that question. At the end of the lesson, teachers circle back to the Essential Question and the class should be able to provide an answer.

Science Notebooks play an important role in this process by:

- Giving students creative space to ask more questions about the lesson opener phenomenon
- Anchoring student learning throughout the lesson around a common concept
- Acknowledging a growing understanding as students look back on their own work later
- Stimulating active reasoning by having students re-write the Essential Question

How can Science Notebooks be used with *Inspire Science*?

- Recording Essential Questions
- Formulating Additional Questions
- Making Personal Connections
- Expanding Labs and Investigations
- Collecting Information from Research

Formulating Additional Questions

Students are inherently curious about the world around them and *Inspire Science* is designed to harness this curiosity and direct the instinctive wonder to scientific investigation. It is natural that questions will arise that fall outside of what is covered in the program. Rather than discouraging this exploration due to time constraints, students should be encouraged to record the questions that arise about what they see, read,

experience, and wonder. Teachers should prompt students to record their questions in their Science Notebooks and then devote time at the end of each lesson to review and discuss them. Students should be encouraged to answer questions based on what they have discovered in the lessons and further investigate questions that have not been addressed. This empowers students to take learning into their own hands and investigate topics of their choosing. Science Notebooks serve an important role in this process by providing a safe space for these queries to live and an organized way to reference them when needed.

Making Personal Connections

Science Notebooks are intended to be a space for students to express their unique perspective on the content and thus, may not be graded in the traditional sense. However, they provide an excellent opportunity for teachers to provide feedback to individual students and build a personal connection. By reading and responding to questions and comments from students about the lessons, teachers are able to gain a better understanding of student comprehension, while encouraging curiosity. This type of informal assessment and feedback is often appreciated by both teachers and students.

Helpful Tip

Leave feedback on sticky notes instead of writing in students' Science Notebooks in order to support a feeling of ownership.

Expanding Labs and Investigations

Inspire Science is an inquiry-based program with rich hands-on experiences. In many situations, students are provided space within the Student Edition to record data and answer questions during these labs, investigations, and projects. In some situations, students are given options to expand these activities or personalize their learning. Students may be asked to test an alternative approach or perform varying iterations of their task. In these situations, their Science Notebooks should be utilized to keep their data organized. This also allows teachers to personalize and expand the activities to suit the needs and abilities of their students. Science Notebooks are an excellent resource for collecting data and completing tasks for other independent assignments as well.

Collecting Information from Research

Throughout the *Inspire Science* program, students are encouraged to find and collect information from authentic sources. Science Notebooks serve an important role in this research by:

- Providing an organized area to take notes
- Personalizing research experiences by allowing students or teachers to decide the best method of recording data according to the type of research being conducted or the preferences of the student
- Erasing the confines of space to allow students to draw images, record data, revise their work, and utilize as much room as needed

Practical Tips for Science Notebooks

As teachers and students get started incorporating Science Notebooks in their *Inspire Science* classroom for the first time, there may be some logistical challenges. As with any new method in the classroom, it may take time for teachers and students alike to adjust to a new system before the benefits are truly realized.

The following practical suggestions are intended as guidelines and may help teachers successfully implement Science Notebooks in their classrooms:

- Use something easily available, such as a spiral notebook or a composition book
- Keep Science Notebooks in the classroom so students don't lose or forget them
- Support creativity and personalization (drawings, lists, graphic organizers, *Foldables*®, etc.)
- Encourage organizing the notebook by lesson
- Collect, read, and provide feedback for Science Notebooks regularly
- Have class sets of glue, scissors, markers and a variety of paper available to students

Helpful Tip

Have students leave the first two pages for a table of contents and add each lesson and the corresponding page numbers as they progress through the school year.

References and Additional Resources

Blueprints for Success: Science Classrooms That Work. (2012) Columbus, OH: McGraw-Hill Education.

Campbell, Brian, and Lori Fulton. (2014). *Science Notebooks: Writing about Inquiry.* (2nd ed.). Portsmouth, NH: Heinemann.

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For more information about *Inspire Science*, visit inspire-science.com.