

ALIGNMENT

Step Up to Writing and the National Academy of Sciences National Science Education Standards

Improving Student Inquiry and Communication

The *Step Up to Writing* program provides effective, multisensory writing strategies* to improve students' overall literacy skills, including students' scientific, mathematic, and technical literacies. This flexible, strategy-based program connects reading, critical thinking and writing to build a common language of literacy and increase proficiency across grade levels and content areas.

Extensive modeling, guided practice, and independent practice improve students' written and oral communication, science reading comprehension, content-specific vocabulary, note-taking, and critical-thinking skills. Students learn to read, write, listen, speak, and view in science-related courses with skill and confidence.

*Step Up to Writing strategies and skills,
combined with innovative science content instruction,
promotes and improves students' abilities of INQUIRY.*

No one can argue that our students must master mathematics, science, and technology. These are critical 21st century skills. The standards reflected in the *National Science Education Standards*** provide the framework for student inquiry and scientific understanding; the *Step Up to Writing* program fits naturally into this educational framework and assists content-area teachers in improving overall K-12 student literacy across the curriculum.

While the National Academy of Science (NAS) provides a foundation and vision for science education in the classroom, *Step Up to Writing* offers concrete strategies, methods, and tools for improving students' comprehension of science content, their ability to communicate science explanations and arguments, their engagement in effective inquiry, and more.

To complement the science education vision created by the National Academy of Sciences, *Step Up to Writing* offers concrete strategies, methods, and tools for improving students' reading comprehension of science textbooks, research reports, and journal articles; their ability to communicate scientific processes concisely and effectively; their consistent understanding and use of content-specific vocabulary; their ability to read and understand science assessments, and more.

Step Up to Writing can be used alone or with other literacy programs already implemented in the classroom. The program provides direction on assessing student writing in the science classroom and also works well with scoring guides or rubrics designed by classroom teachers, schools, school districts, state, and other professional groups.

* All Strategy and Section references in this document refer to *Step Up to Writing*, Third Edition (2008). The program also applies to the content, tools, and strategies found in the First and Second Editions and in *Step Up to Writing in Math* (2008).

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SCIENCE CONTENT STANDARDS

The National Academy of Sciences content standards provide the framework of K-12 science education. Strategies and activities in *Step Up to Writing* can assist teachers in their instruction of specific discipline areas such as physical science and life science, and the history and nature of science.

Step Up to Writing's most important contribution to science education is its promotion and support of *student inquiry* and improving students' abilities to engage in inquiry methods and to intelligently communicate their hypothesis, investigative procedures, data/findings, and analysis in writing.

Step Up to Writing strategies, activities and lessons support teachers' efforts to develop students' abilities to conduct scientific inquiry and communicate, defend, and analyze scientific arguments

Standard 1: Unifying concepts & processes

Standard 2: Science as inquiry

Standard 3: Physical science

Standard 4: Life science

Standard 5: Earth & space science

Standard 6: Science & technology

Standard 7: Personal & social perspectives

Standard 8: History & nature of science

My Notes _____

SCIENCE AS INQUIRY

The NAS *National Science Education Standards* states, “As a result of activities in grades K-12, students should develop:

- Abilities necessary to do scientific inquiry;
- Understanding about scientific inquiry.”

Step Up to Writing & Scientific Inquiry

The research-based, multisensory writing strategies contained in the *Step Up to Writing* program aid teachers’ scientific literacy instruction and help develop students’ abilities and understanding of scientific inquiry. The *Step Up* strategies are active, hands-on, “minds-on” approaches reflecting the core concepts of inquiry and strong scientific education. *Step Up to Writing* can work with all grade levels and developmental capabilities.

While scientific inquiry will vary with grade level and student abilities, there is a general process identified by NAS for engaging in inquiry.

Inquiry Process

- ◆ **Identify key questions and concepts to guide the investigation**
- ◆ **Plan, design, and conduct the scientific investigation**
- ◆ **Gather, analyze, and interpret data with appropriate tools and techniques**
- ◆ **Formulate and revise scientific explanations using data and evidence**
- ◆ **Recognize and analyze alternatives; think critically and logically**
- ◆ **Communicate investigations, procedures, and explanations; defend a scientific argument**
- ◆ **Use mathematics in all aspects of scientific investigations**

◆ ***Identify key questions and concepts that guide the scientific investigation***

Step Up to Writing provides teachers with strategies for asking and answering critical questions. Whether students are using teacher-generated scenarios or engaging in individual experiments, it is necessary that they formulate a testable question or hypothesis. *Step Up* offers activities that engage students in different levels of questioning, organizing and writing questions, and responding to the questions. The reading and thinking strategies also help students comprehend, analyze, and work with science textbooks and other written materials to build a scientific knowledge base from which to identify and formulate key inquiry questions. Similarly, *Step Up* strategies provide lessons covering research methods and collecting and organizing facts.

For example:

- Section 1: Writing to improve reading and listening comprehension (Responding to information in the text; making connections to self/text/world; marking/annotating the text; taking informational and reflective notes; making inferences and analyzing; retelling and summarizing information; asking and answering questions; research methods; collecting and organizing facts; mapping and webbing)
- Section 2: Vocabulary (Developing and using a strong content-specific vocabulary – the language of science; breaking down definitions; concept and word maps; writing meaningful sentences; using precise word choice; vocabulary study guides)

♦ ***Plan, design and conduct the scientific investigation***

The strategies and activities in *Step Up to Writing* help students learn the necessary science subject matter required to plan, design, and conduct their scientific inquiry. Teachers can model active reading strategies that enable students to comprehend and gain knowledge from resources such as textbooks, online articles and reports, other scientists' work, as well as students' own investigations. The various outlining and note-taking strategies designed for organizing writing also apply to students' planning and design of their investigation. Students engage in various "write to learn" and reflection activities that help them clarify ideas and formulate questions that guide their experiments. Teachers are able to quickly and easily assess students' methodologies and approaches to inquiry by reading their outlines, notes, and "write to learn" assignments; as a result, teachers can intervene early in the investigation if necessary and/or challenge students' thinking even further.

The students' peers are also a critical component of the design and execution of the scientific experiment. *Step Up to Writing* promotes and supports the opportunity for students to engage in peer review at any step in the investigative process. Teachers can demonstrate various peer review strategies designed to help students obtain feedback on their investigative plan, clarification of unclear questions, data analysis, and presentation of results.

For example:

- Section 1: Writing to improve reading and listening comprehension (Responding to information in the text; making connections to self/text/world; marking/annotating the text; taking informational and reflective notes; making inferences and analyzing; retelling and summarizing information; asking and answering questions; research methods; collecting and organizing facts; mapping and webbing)
- Section 2: Vocabulary (Developing and using content-specific vocabulary – the language of science; breaking down definitions; concept and word maps; writing meaningful sentences; using precise word choice; vocabulary study guides)
- Sections 4 and 5: Information/expository paragraphs, essays, and reports (Informal outlines; the writing process; organization; planning guides; defining a topic sentence/main idea/key question; developing ideas)
- Section 9: Specific writing assignments (Writing in science; science reports; writing to explain a graph or other visual representation of information; writing for assessments; technical writing; writing in math; persuasive and argument writing; compare/contrast; cause/effect and problem/solution; how-to and process analysis; personal response and reflection; descriptive or observational writing; writing an opinion with facts)
- Section 10: Assessment and high standards (Setting high standards and clear expectations; peer review; editing with CUPS – capitalization, usage, punctuation, and spelling; quick checks for self-evaluation; practical, effective assessment; scoring guides with *below basic*, *basic*, *proficient*, and *advanced* writing samples; monitoring student progress)

♦ ***Use appropriate tools, techniques, and technologies to gather, analyze, and interpret data***

While *Step Up to Writing* doesn't provide specific instruments, tools, and technologies for conducting scientific inquiry, the program does include strategies for observing, collecting, analyzing, working with, and displaying data/evidence. This includes critically reading information, taking notes, creating outlines, understanding and using science vocabulary, developing explanations, reading and displaying information in visual representations (e.g. charts, graphs, etc.). *Step Up* promotes using technology whenever possible to aid students' writing and communication. Teachers are encouraged to adapt the various writing assignments to help students gather, organize, and report data.

For example:

- Section 1: Writing to improve reading and listening comprehension (Responding to information in the text; making connections to self/text/world; marking/annotating the text; taking informational and reflective notes; making inferences and analyzing; retelling and summarizing information; asking and answering questions; research methods; collecting and organizing facts; mapping and webbing)
- Section 2: Vocabulary (Developing and using content-specific vocabulary – the language of science; breaking down definitions; concept and word maps; writing meaningful sentences; using precise word choice; vocabulary study guides)
- Section 3: Sentence mastery (Writing better sentences; varying sentence structures; recognizing parts of speech; sentences using *who*, *what*, *where*, *when*, *why*, and *how*; considering audience, purpose, and message)

- Sections 4 and 5: Information/expository paragraphs, essays, and reports (Informal outlines; the writing process; organization; planning guides; defining a topic sentence/main idea/key question; developing ideas)
- Section 9: Specific writing assignments (Writing in science; science reports; writing to explain a graph or other visual representation of information; writing for assessments; technical writing; writing in math; persuasive and argument writing; compare/contrast; cause/effect and problem/solution; how-to and process analysis; personal response and reflection; descriptive or observational writing; writing an opinion with facts)
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♦ ***Use data/evidence to formulate and revise scientific explanations and models (describe, explain, predict)***

This standard focuses on students' critical thinking, a key literacy skill in any content area. With *Step Up to Writing* students learn strategies for organizing and analyzing their data and evidence from which to build their scientific arguments and explanations. Strategies for incorporating evidence, details, reasons, and support into their writing are abundant throughout the *Step Up* program. Teachers can discuss and model specific ways students can identify key topics, elaborate on ideas, and create conclusions to their research. These writing and thinking skills are the lead-up to creating the final scientific report or analysis and presenting the findings publicly.

For example:

- Section 1: Writing to improve reading and listening comprehension (Responding to information in the text; making connections to self/text/world; marking/annotating the text; taking informational and reflective notes; making inferences and analyzing; retelling and summarizing information; asking and answering questions; research methods; collecting and organizing facts; mapping and webbing)
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♦ ***Recognize and analyze alternative explanations, predictions, and models; think critically and logically about evidence and explanations***

Creating a strong, logical scientific argument is no different, fundamentally, than creating arguments in other subject areas such as history, English, and debate. *Step Up to Writing* offers students critical reading strategies that help them take notes and review their data, summarize and paraphrase their findings, and form their argument or explanation. Specific writing assignments (which are adaptable to specific classroom goals and activities) teach students to identify and write about cause-and-effect or problem-solution relationships. Similarly, students learn how to compare-and-contrast their findings with information from other scientific resources and present this information accurately and effectively.

For example:

- Section 1: Writing to improve reading and listening comprehension (Responding to information in the text; making connections to self/text/world; marking/annotating the text; taking informational and reflective notes; making inferences and analyzing; retelling and summarizing information; asking and answering questions; research methods; collecting and organizing facts; mapping and webbing)
- Section 2: Vocabulary (Developing and using content-specific vocabulary – the language of science; breaking down definitions; concept and word maps; writing meaningful sentences; using precise word choice; vocabulary study guides)
- Section 3: Sentence mastery (Writing better sentences; varying sentence structures; recognizing parts of speech; sentences using *who, what, where, when, why, and how*; considering audience, purpose, and message)
- Sections 4 and 5: Information/expository paragraphs, essays, and reports (Informal outlines; the writing process; organization; planning guides; defining a topic sentence/main idea/key question; developing ideas)
- Section 9: Specific writing assignments (Writing in science; science reports; writing to explain a graph or other visual representation of information; writing for assessments; technical writing; writing in math; persuasive and argument writing; compare/contrast; cause/effect and problem/solution; how-to and process analysis; personal response and reflection; descriptive or observational writing; writing an opinion with facts)
- Section 10: Assessment and high standards (Setting high standards and clear expectations; peer review; editing with CUPS – capitalization, usage, punctuation, and spelling; quick checks for self-evaluation; practical, effective assessment; scoring guides with *below basic, basic, proficient, and advanced* writing samples; monitoring student progress)

♦ ***Communicate scientific investigations, procedures, and explanations; defend a scientific argument***

Step Up to Writing is probably most identified with improving students' written and oral communication skills. In this case, students' abilities and confidence in communicating their scientific investigation, procedures, data, and explanations. Teachers can use the explicit writing and speaking strategies to improve students' overall writing skills, to discuss scientific information intelligently and accurately, to present – formally and informally – their results, and to critique their own and others' work. The various writing strategies and assignments help students develop abilities associated with the goals from the *National Science Education Standards*:

- “writing and following procedures,
- expressing concepts,
- reviewing information,
- summarizing data,
- using language appropriately,
- developing diagrams and charts,
- explaining statistical analysis,
- speaking clearly and logically,
- constructing a reasoned argument,
- and responding appropriately to critical comments” (p. 176).

For example:

- Section 1: Writing to improve reading and listening comprehension (Responding to information in the text; making connections to self/text/world; marking/annotating the text; taking informational and reflective notes; making inferences and analyzing; retelling and summarizing information; asking and answering questions; research methods; collecting and organizing facts; mapping and webbing)
- Section 2: Vocabulary (Developing and using content-specific vocabulary – the language of science; breaking down definitions; concept and word maps; writing meaningful sentences; using precise word choice; vocabulary study guides)
- Sections 4 and 5: Information/expository paragraphs, essays, and reports (Informal outlines; the writing process; organization; planning guides; defining a topic sentence/main idea/key question; developing ideas)
- Sections 6 and 7: Story and narrative writing, personal narrative (Planning and prewriting; developing characters; writing dialogue; recognizing the personal narrative pattern; sharing and publishing their writing)

- **Section 8: Speeches** (Planning, organizing, and delivering effective speeches and presentations – formal and informal; asking and answering questions; improving impromptu speaking, informational and how-to speeches, and persuasive speeches; focusing on your audience; developing good listening skills; participating in a discussion)
- **Section 9: Specific writing assignments** (Writing in science; science reports; writing to explain a graph or other visual representation of information; writing for assessments; technical writing; writing in math; persuasive and argument writing; compare/contrast; cause/effect and problem/solution; how-to and process analysis; personal response and reflection; descriptive or observational writing; writing an opinion with facts)
- **Section 10: Assessment and high standards** (Setting high standards and clear expectations; peer review; editing with CUPS – capitalization, usage, punctuation, and spelling; quick checks for self-evaluation; practical, effective assessment; scoring guides with *below basic*, *basic*, *proficient*, and *advanced* writing samples; monitoring student progress)

♦ ***Use mathematics in all aspects of scientific inquiry***

See the newly published *Step Up to Writing in Math* (2008) for strategies, activities and lessons designed to improve students' use of mathematical language and content-specific vocabulary as well as their ability to communicate accurately and effectively their mathematical thinking and processes.

Because mathematics are such an integral part of scientific inquiry, *Step Up to Writing in Math* is an excellent resource for both math and science teachers.

REFERENCES

Auman, Maureen. *Step Up to Writing*. 3rd ed. Boston: Sopris West Educational Services, 2008.

National Committee on Science Education Standards and Assessment, National Research Council. *National Science Education Standards*. Washington DC: National Academy Press, 1996. 12 Sep 2008 <http://www.nap.edu/catalog.php?record_id=4962>

See also:

Auman, Maureen and Debbie Valette. *Step Up to Writing in Math*. Boston: Sopris West Educational Services, 2008.

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- Section 1: Vocabulary
- Section 2: Reading & Note Taking
- Section 3: Summarizing
- Section 4: Asking and Answering Questions
- Section 5: Writing for Assessments
- Section 6: Writing for General Assignments
- Section 7: Creative and Personal Writing