Science Poetry in Two Voices: Poetry and the Nature of Science

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Abstract

Poetry can be used during science instruction to foster interest, excitement, and wonder among elementary-level students. Children can read poetry, or have poetry read to them, as a way of learning about their world. They can also create poems to share their own science learning with others. We introduce two formats of the Poetry in Two Voices form of poetry (namely, Five Senses in Two Voices and Scientific Approach in Two Voices) that we use to help students in Grades 1-5 develop science observation skills and adopt a scientific approach during their science investigations. Integrating poetry with science is a historically accurate pedagogical approach in that poetry was at one time the language of philosophy and science. The purpose of this action research report is to share our experiences and the results of utilizing these two poetry formats with elementary-level children.

Poetry in Two Voices

Poetry in Two Voices (see Figure 1) is a form of poetry created by Paul Fleischman (see *Paul Fleischman's Official Website*, n.d.). In his book, *Joyful Noise: Poems for Two Voices*, Fleischman (1988) used poetry to describe the natural world around us. Poetry in Two Voices requires two readers. One person reads lines on the left side of the page while the second person reads lines located on the right. The lines of text are sometimes contrasting, but always complementary. Readers begin at the top of the page and take turns reading their lines. Text printed on the same horizontal line is read in unison by both readers.

Poetry does not have to rhyme. According to the Miriam-Webster dictionary, poetry (n.d.) is "writing that formulates a concentrated imaginative awareness of experience in language chosen and arranged to create a specific emotional response through meaning, sound, and rhythm." Meant to be read aloud, poetry in two voices establishes its rhythm by the poet or poets' thoughtful word selection and interplay between voices by conscientiously alternating readers. Consistent with Fleischman's (1988) poetical works, students can be encouraged to also include rhyme, alliteration, simile, metaphor, and personification in their poems.

The Nature of Science

Poetry in Two Voices can mimic the nature of science (American Association for the Advancement of Science [AAAS], 1993; Council of Ministers of Education, Canada [CMEC], 1997; Curriculum Council of Western Australia [CCWA], 1998; Lederman, 1992; Millar & Osborne, 1998) in four important ways. First, an important aspect of science is to ask questions about natural phenomena experienced and to seek answers through observation. Throughout the academic year, we explicitly and repeatedly refer to this with students as the *nature of science*. To help children better understand the nature of science, we use a modification of Poetry in Two Voices that is based on questions and answers, and the templates of Figures 2 and 3 provide examples of the two printed formats that we use with students. As student scientists, elementary-level students ask questions and seek answers through science investigations. Using this approach, students create poetry that requires two readers and mimics the nature of science. With the exception of a few introductory lines and a line designated for a closing exclamation, one reader

asks questions and the other reader provides answers based on what they did and learned during their observations and/or science investigation. Consistent with the nature of science, poems are written so that the readers sometimes read the same words in unison when consensus has been achieved, while the words of each reader may be different when no data-driven consensus has been reached.

Reader 1	Reader 2
I am reader one.	
	I am reader two.
Our students love poetry.	
	Yes, it's true.
Our students love science.	
	Truer still!
Poetry in two voices . . .	
	is read by two people.
I read the left.	
	I read the right.
Sometimes we read . . .	
in unison.	in unison.
Two voices can share . . .	
	what we observe.
Two voices can share . . .	
	our science investigations.
I ask the questions.	
	My answers are based on observations and investigations.
Just like . . .	
science!	science!

Figure 1. Science Poem in Two Voices (by W. Frazier and K. Murray). Readers alternately read their lines, with lines on the same horizontal being read in unison.

_____
(Title)

(Reader 1)	(Reader 2)
_____*!*	
	_____*!*
_____*?*	_____*?*
What do we see with our eyes?	
	_____
What do we hear with our ears?	
	_____
What do we feel with our skin?	
	_____
What do we taste with our tongue?	
	No! No! No!
What do we smell with our nose?	
	_____
_____*!*	_____*!*

Examples of prompts for the opening lines:

(What is it?)

(An observation)*!*

(Another observation)*!*

(A question related to the use of the senses)*?*

(The same question repeated)*?*

Instructions for the last line of the poem can be decided by the teacher and class, but students should be instructed to use identical words on the left and right sides to convey to their audience that a consensus has been reached based on observations (either in the student's mind if sole author, within the small writing group, or across the class when creating a class-wide poem). If students have been observing a mystery item, the last line could be the children's inference about the identity of the mystery item, a really cool descriptive word that describes the object, the purpose of the object, or the name of the object restated.

Figure 2. Poetry template: Five Senses in Two Voices.

_____
(Title)

(Reader 1)	(Reader 2)
_____*!*	
	_____*!*
_____*?*	_____*?*
What is our question?	
	_____
What else do we need to know?	
	_____
What is our prediction/hypothesis[a]*?*	
	_____
How do we test our prediction/hypothesis[a]*?*	
	_____
What are our results?	
	_____
Eureka!	*Eureka!*

[a]Older students can be asked to distinguish between these two terms by drawing a line through the one that does not apply.

Examples of prompts for the opening lines (which are decided by teacher and class):

(A title that conveys the topic)

(First word of topic)*!*	
	(Second word of topic)*!*
(A descriptive word related to topic)*?*	(The same word repeated)*?*

The last line of the poem follows with "*Eureka!*" (on both left and right sides, thus being exclaimed in unison) to consistently convey to children that experimental findings are important whether or not their findings support the stated prediction/hypothesis.

Figure 3. Poetry template: Scientific Approach in Two Voices.

Second, scientists are creative in the ways they solve problems (AAAS, 1993; Lederman, 1992). Elementary students are frequently taught the "steps of the scientific method" as the principal strategy for learning about their world, but what is lost is the creative nature of the science

discipline. There are a multitude of ways in which scientists go about "doing science." By having students create poems about their science observations and investigations, the underlying message is that creativity and science go hand-in-hand. Creativity is evidenced by forming new ideas, insights, restructurings, and inventions of scientific value and real-world application (Vernon, 1989). To be creative, the novice scientists in the elementary classroom, as well as experienced scientists in the laboratory, require an understanding of science concepts that is fluid, flexible, and complex (Guilford, 1950). Additionally, novice scientists and experienced scientists alike need positive attitudes toward creativity and risk-taking (Bereiter & Scardamalia, 2006; Lubart, 1994; Sternberg & Lubart, 1991; Sternberg & Williams, 1996), and they need to operate in design mode (Bereiter & Scardamalia, 2006) where their focus is on the application of what they learn. In this case, we ask children to focus on applying what they learn to their creation of poems in order to communicate their observational and/or experimental findings. Cumulatively, we help students develop the three components of creativity through utilization of poetry in two voices: Ability to think creatively, positive thoughts about being creative, and purpose for action (Sternberg, 2006). While we present two templates for supporting children's work, please understand that the templates can and should be modified by teacher and students to fit the particular investigative strategies the children are using to learn more about their world.

Third, integrating poetry into science conveys to students the importance of sharing their scientific learning with others. This aligns with the nature of science as a body of growing knowledge that is meant to be shared (AAAS, 1993; Lederman, 1992). To quote one elementary student: "They listened to my poem because my poem was funny and what I found out was important." When queried further about what the student meant by "funny," she explained that their group had a particular question in mind that they wanted to answer, but they were surprised by how nothing in their investigation went as planned. In fact, her group ditched their idea of performing a controlled experiment and decided that their question would be better answered with a survey. Grounded in the sharing of answers to questions raised about the world around us, the two poetry formats introduced in this paper can be used by teachers and children alike as a form of communicating scientific literacy that simultaneously conveys the creative aspects of the nature of science to the elementary classroom audience.

Fourth, poetry in musical verse was at one time the language of philosophy and science. In ancient times originating before the birth of formal education in the 5th century B.C., children of the ruling class of ancient Greeks studied "*gymnastyke* for the body and *mousike* for the mind or spirit. . . . *Mousike* covered all of the arts presided over by the muses, especially music and poetry" (Lindberg, 2007, p. 68). Ancient Greek mythology, as an example of mousike, illustrates the blending of poetry and explanation of natural events (Lindberg, 2007). Later, the historical divide between science and poetry can be attributed to Aristotle (384-322 B.C.), who in his *Poetics* (Aristotle, 4th century B.C./1812) began to differentiate between work driven by creative, imaginative liberties versus work driven by his definition of scientific thought. However, poetry continued to be an avenue for the communication of scientific thought. Examples, both before and after Aristotle, include *On Nature* (Empedocles, 5th century B.C./1898), *Peri Physeos* (Parmenides of Elea, 475 B.C./1996), *Phaenomena* (Aratus of Soli, 3rd century B.C./1921), *De Rerum Natura* (Lucretius, 1st century B.C./2003), and *Astronomica* (Manilius, 1st century A.D./1977). Despite this ancient tradition of poetry having been used to communicate scientific ideas, the significant divide between science and artistic endeavors set in motion by Aristotle continues today. To bridge the "two cultures" gap noted by Snow (1959, p. ix), we return to a unity of science and poetry in the classroom.

Poetry Template for Observations

Student scientists collect data using their sense of sight, touch, smell, hearing, and sometimes taste. The poetry template Five Senses in Two Voices (Figure 2) guides students' observations. When asked to make observations, we find that children frequently forget to use all their senses. They might focus more on touch or sight, while ignoring opportunities to listen and smell. Additionally, they might want to taste something that the teacher would rather they did not. Using this template also encourages students to apply new vocabulary they learn through written prompts in the form of questions. As a result, this template helps students make more complete and descriptive observations safely. One teacher explained as follows:

> The entire poetry format serves as an effective series of prompts to support children's observations and written recordings incorporating new vocabulary. While the template is simplistic, this is exactly what children need to help them understand that systematic observation and communication of findings is what scientists do.

Appendix A contains a series of poems written while elementary students observed both the materials used to make "Goop," and then the Goop itself, during a unit on the physical states of matter. Goop is a colloidal suspension that has characteristics of both solids and liquids. Goop can be made by combining 1 part water with 2 parts cornstarch in a shallow container, such as a disposable pie pan. Cornstarch is an edible, fine powder commonly found in the baking section of the grocery store and is frequently used to thicken gravy. Students can observe water, cornstarch, and the results of combining water with cornstarch to form Goop with their senses. Please note that in these poems we gave the students permission to taste the substances since classroom conditions allowed for appropriate hygiene and safety during their observations. If the particular substance children are observing in your classroom should not be tasted, then the line "No! No! No!" can be inserted in advance to remind students not to taste the substance, as shown in Figure 2.

It is important to monitor students' thoughts and feelings both during and after this poetry writing experience. In one classroom, students were surprised by the variety of observations in the poems that they shared and wanted to swap their samples of Goop with other students and then write a new poem. Allowed by the teacher to do so, students discovered that the use of different proportions of cornstarch and water, which were the result of simple human error, produced varying consistencies of Goop that behaved differently. One student hypothesized: "I think everybody's Goop was different because we weren't careful and splashed water on the sidewalk when pouring it in." Additionally, providing one line only for a student response may constrain some children's thinking, so lines, as well as the template itself, can be expanded as needed. As one student remarked: "I like adding lines because it's hard to make it all fit. I talk a lot and my poems have more words than everybody's."

Emphasis on a variety of modes for observation is important, since approximately 30% of elementary students may be primarily visual, 25% primarily auditory, and 15% primarily tactile-kinesthetic learners, with an additional 30% of learners exhibiting a mixed, multi-mode preference (Khalsa & Miyake, 2005). We consider it pedagogically sound to inclusively address children's different learning styles, due to different prioritizations of their sensory modalities. Engagement, variation in modality, differences in sensory primacy, and variation in learning style may best be approached through sufficient motivation, clarity, and connection to prior knowledge and to their intuition and sensory awareness of the world around them.

Poetry Template for Using a Scientific Approach

The second poetry format, Scientific Approach in Two Voices, guides children's use of a scientific approach as one of many strategies for learning about their world (Fleener & Frazier, 2004; Frazier & Fleener, 2004). Figure 3 provides the template for this poetry format. During whole-class investigations, teacher and students complete the first few lines of the poem together before performing the investigation. The poem is then completed and read aloud once the class has collected and made sense of their data. When the time comes to read the poem aloud, the teacher can read lines on the left while the whole class reads lines on the right. Alternatively, the class can be split in half with one half reading lines on the left side of the page and the other half reading lines on the right. According to our students, reading poems that have been created by the whole class aloud is an experience that they really enjoy for a variety of reasons stemming from students' perceived novelty of this poetry format. The novelty is further enhanced through variation in how the poem is read aloud, the higher value that students place on reading what they have created together versus an assigned reading from an unknown author, the students' perceived ownership and pride in the poetry they have worked to create, the low-risk experience of reading text in unison with their peers, and the positive feedback and encouragement they receive from their teacher to be creative while drafting their class poem. From our experience, even children who are not interested in the investigation are very interested in finishing the poem. Some children do the investigation just so they can read the poem aloud with the rest of their classmates.

Appendix B contains an example of a poem created by a class of students while examining the effect of the concentration of soap in water on the germination of seeds during a unit on plants. In this experiment, radish seeds were placed in Ziploc bags with a paper towel, and each bag was watered with a different concentration of soap solution (0%, 10%, 20%, and 30%). We demonstrated how to make these soap solutions for our students. Appendix C contains instructions for how to make soap solutions in various concentrations and for watering. Students recorded their observations of plant growth for the next 3 weeks and created several different versions of their poems based on what they observed over time.

Appendix D contains a poem that a small group of students created during an animal senses unit. They were trying to develop a habitat for their mealworms that the mealworms could not escape from, and wanted to know what mealworms can climb. After considering various hypotheses that comprised the texture, color, smell, and flexibility of the surface, they decided to investigate the first; surface texture. They compared the distances mealworms traveled on a slightly slanted tabletop lined with surfaces they organized from smoothest to roughest: Plastic wrap, notebook paper, and sandpaper. Even when groups of children perform the same experiment across the class, the group poems vary. The variety of poems increases engagement in the communication process as individual students listen to the differences in each others' poems versus the traditional alternative of listening to different groups share the same thing over and over. As one teacher remarked:

> I used to dread when it was time for students to share their experiment findings. I felt so bad because each of them had really invested a lot of time in their experiments, but let's face it, sharing the same thing repeatedly across groups gets boring quickly. However, sharing poems is very different. The students really respect and support each other. I would say this has been the most significant change in my classroom that I have ever experienced.

Using Poetry to Assess Science Vocabulary and Observation Skills

We use these two poetry formats to assess our students' development and understanding of scientific vocabulary and skills. In the early-elementary grades, students learn how to use words (e.g., colors and shapes) and word pairs (e.g., rough-smooth, curved-straight, and fast-slow) to describe their surroundings. When early-elementary students create poems as a class using the Five Senses in Two Voices format, we determine alternative conceptions in students' science vocabulary development through examination of their word choice with respect to scientific literacy and model appropriate usage. For example, while describing the texture of a surface, a child may refer to the surface as "rough" versus "soft" rather than "rough" versus "smooth."

In the worksheet examples of Appendix A, students originally wanted to use the words "weird, yummy, good." As a result, the teacher encouraged the children to be more specific and precise with their word choice. Students ended up choosing more descriptive words, such as cold, clear, wet, white, and smooth. Here, we find that brainstorming descriptive words in advance and recording them on a word/reference wall really helps and provides additional opportunities to enrich vocabulary. Developing and reading poetry aloud, including opportunities for rehearsal and practice with a peer, also provides a low-risk opportunity for English Language Learners to practice their developing language skills (Hadaway, Vardell, & Young, 2001). To best assist students, the teacher should monitor which student reads words on the left and which student reads words on the right to ensure that each child is appropriately challenged and supported in their language development. Readers of the left side have an opportunity to read teacher-structured questions that model appropriate grammatical usage of teacher-selected vocabulary, while readers on the right side have an opportunity to read less predictable phrases that incorporate new vocabulary but generally model less appropriate grammatical usage.

Across the elementary grades, the Five Senses in Two Voices format helps children organize their thoughts and ideas into words. In the examples of Appendix A, the first- and second-grade students used their series of poems to explore, organize, record, and share their observations. From this series of poems, we observe students' natural tendency to question, predict, and try to confirm ideas based on observation. As another example, upper-elementary children in Grades 4-6 can observe baking powder mixed with vinegar to learn about the characteristics of a chemical change. The students can record, in a chart as a class, their observations before, during, and after mixing the baking soda and vinegar. Students can refer to this observation chart as they develop a series of three Five Senses in Two Voices poems to describe a chemical reaction in terms of what they observed throughout the process.

Using Poetry to Assess Adoption of a Scientific Approach

In the upper-elementary grades, the Scientific Approach in Two Voices format can be used to assess children's adoption of a scientific approach as one of many strategies for learning more about their world. During their investigations, our students complete a data table of their recorded observations along with their poem. We compare a student's data table and poem so we can determine how accurately the student is able to interpret findings and use findings to make a decision about a prediction. To ease our work as teachers, we instruct students to state their poem's prediction in two parts as an "if . . . then . . . " statement. The first part of the prediction describes a purposeful change the student will make to the independent variable. The second part of the prediction describes what happens to the dependent variable when the independent variable is changed. By reading the prediction, we can determine if the student has correctly identified the independent and dependent variables. In the case of the poem in Appendix B, the group correctly defined their independent variable as the amount of soap added to the water used to irrigate radish

seedlings. However, they inaccurately defined their dependent variable as the length of the seed rather than the length of the root. The poem helped us identify this misconception so we could address it with the group. When queried further, it was discovered that this group thought that the seed would turn into a radish rather than the radish developing as a taproot. A student explained: “After we read our poem, our teacher had my group look at this website that helped me see what a radish is when it’s still in the dirt.”

The Scientific Approach in Two Voices format also helps us determine if students’ beliefs, thoughts, and practices are consistent with the nature of science (AAAS, 1993; CCWA, 1998; CMEC, 1997; Lederman, 1992; Millar & Osborne, 1998). Often children want to say their hypothesis is “wrong” after a single test, without reflecting on the validity of their results. Data can fail to support a hypothesis and even contradict a hypothesis, but substantial testing and assurance of valid testing conditions are required to actually falsify a hypothesis. To further complicate matters for students (and teachers), hypotheses can never be proven true due to the tentative nature of science as a continuously evolving body of knowledge based on observations forming laws and hypotheses forming theories, both of which are subject to change, though laws less so (AAAS, 1993). To aid students in thinking critically about their investigations and results, they are therefore encouraged to decide if their data supports or does not support their hypothesis, helped to shift away from thinking that hypotheses can be proven true, and also helped to recognize that substantial data and validity assurances are required to falsify a hypothesis. Appendix E contains an example of a poem where the students' thinking is consistent with the nature of science as they make a decision about their hypothesis when their data failed to support it. In this experiment, students made ice cream and a group of students hypothesized that their ice cream ingredients would freeze faster if they used milk with a higher concentration of fat in it. (See Appendix F for instructions on how to make ice cream using plastic bags with elementary-level students.) Different student groups elected to use skim milk, 2% reduced fat milk, and whole milk. The class performing the experiment found that groups using skim milk had ice cream quicker than those groups that used reduced fat or whole milk. Rather than stating that their hypothesis was wrong because of this one single experiment, the students recognized that they still have much work to do in fully testing their hypothesis that fat concentration influences freezing rate, which they referred to as "do over" on the last line (i.e., the students opted to continue testing their original hypothesis after clarifying the procedures of their controlled experiment to better ensure a valid result).

Additionally, we want our students to develop a positive attitude towards investigations that do not turn out as they expect. We find that children are frequently disappointed when their data does not support their prediction. We encourage our students to write poems using the Scientific Approach in Two Voices format for all of their investigations, even the ones that have unexpected results. As a result, children take ownership of their findings and realize that even when an investigation does not support their prediction, their findings are still worthy of being shared with others.

For the poem shown in Appendix E, the group of students opted to change the last line from “Eureka!” to “Do over,” and we continued to work with this group to help them understand that their finding was a “eureka moment” even though their prediction was not supported by their data. One student explained: “We didn’t have a right prediction, but that’s ok. I guess we could create a new poem, but we don’t have to. That’s just science: ‘You get what you get and you don’t throw a fit.’ Our teacher was telling us about how scientists get surprised, too.” We used this opportunity to discuss with students different formats for predictive statements, especially when the independent or dependent variable is not a directional, continuous variable. The students also

discussed whether or not they should use a controlled experiment or if there is a better strategy to use to answer a question. A different student explained her reason for selecting a controlled experiment:

> When creating our "questions poem," at first I really wanted to do a survey to see which ice cream people like best and that's ok to do, but we did a controlled experiment instead, so we could mix the different ingredients together more, and see and feel what happens, and write a poem with answers that were facts. Mixing stuff together and seeing what happens is more fun and it's facts while surveys are opinions and people can change their mind.

As further testament to how utilizing this particular form of poetry helps students and teachers better understand the nature of science, one teacher explained:

> Having a poem based on questions and answers is important. Using either template helps me remember that science is about having a question, or series of questions, and finding answers. This means that the students and I are both asking questions, but the students have the responsibility for collecting information through their observations and investigations to discover answers. They shouldn't only get the information from me or a textbook or the web. Science is about getting the children moving, exploring, and learning. Most of all, it is about getting them to think, plan, observe, draw conclusions, and ask more questions. I find that the templates help me remember this, just as much as they help my students remember.

Additionally, one second-grader concisely explained: "The poem is just like science. It's questions and answers. Sometimes I ask the questions, sometimes I don't, but I find the answer with my four senses . . . sometimes five."

The use of poetry in intellectual endeavors pre-dates Aristotle's empiricism in the 4th century B.C. and the modern scientific approach developed by Ibn Al-Haytham in the early 11th century A.D. (Steffens, 2007), and yet is coherent with the inquiry skills we desire to instill in students. Later echoes of the pre-Aristotelian tradition that illustrate an integration of poetry and inquiry span from Antipater's poem from the 1st century B.C. (that includes description of a water-driven mill) (Landels, 2000) through Chaucer's "The Canon's Yeoman's Tale" (a satirical work about the practice of alchemy written sometime in the latter half of the 14th century) (Purvis, 1870), Edgar Allen Poe's "Sonnet: To Science" (Poe, Ingram, & Willis, 1902) written during the 1800s, to modern-day Paul Fleischman's (1988) collection of nature poetry in *Joyful Noise: Poems for Two Voices* upon which the strategies being shared in this article are based.

A Surprise to Us

We are amazed by how frequently the children mentally call upon the templates during their investigations. The templates for writing poetry in Figures 2 and 3 can simultaneously be used as a powerful and long-lasting metacognitive prompt to support children's design and performance during science investigations throughout the year. Metacognitive prompts provide hints to children to guide their thought processes during classroom activities (Zimmerman, 1989). By thinking in a manner similar to scientists, children systematically learn more about the world around them. As one student explained: "I really like having an old senses poem [Figure 2] in my notebook. I use it to remember to use all of my senses because sometimes you forget one you know. The other poem [Figure 3] helps me remember what to do when doing experiments because I sometimes get nervous and forget; it helps me you know."

Modern Scientists and Poetry

Beyond ancient times, there has been a long, continuing tradition of major scientists who write poetry to communicate their scientific ideas, and this long-standing tradition provides a rationale for integrating poetry with science during instruction today as a vehicle for children to share their science learning. Providing examples to children of science-related poetry, which spans the centuries from the Ancient Greeks to current times, makes explicit to students how language arts and science are related through a long history of integration. Additionally, incorporating these authentic examples into the classroom can foster students' motivation and interest. For example, children may be intrigued to discover that Oliver Wendell Holmes worked as a physician in the 1800s and wrote a number of poems including "Extracts From a Medical Poem" (Holmes, 1850), which could be read by the teacher to the class or in a literacy circle. As another example, teachers might share excerpts from the following books of poetry of Nobel Prize-winner in chemistry, Roald Hoffmann (1987, 1990, 2002): *The Metamict State*, *Gaps and Verges*, and *Soliton*. More accessible to elementary-age children, modern day paleontologist Richard Fortey wrote *The Dinosaurs' Alphabet* (Fortey, 1990), which is a collection of poems about 26 dinosaurs--one for each letter of the alphabet.

Try It!

When "doing science," these two poetry templates provide a structured, yet creative, outlet for children by structuring their observations and investigations. Students use their language arts skills to share their observations and results in a way that is meaningful for themselves and others. We find that the real joy comes when the children read their poems aloud. Try both templates with your students to enhance their learning and interest in science through poetry. As students become more familiar with the two formats, we recommend that you modify the number of lines, and the templates themselves, to support students' expanding ideas about their world around them. As one student explained: "I didn't think our teacher would let us change the poem['s format], but she did. We could add parts in to fit our experiment. Scientists are creative [, so] our poem is unique."

Use of Poetry in Two Voices during science instruction does not have to be limited to just one or two classrooms. Beyond use in a single classroom, Poetry in Two Voices via the two templates shared in this paper can be used to increase the intellectual vigor of an entire school's science program. One teacher explained:

> I really like how the observation poem format is perfect for the early grades and the scientific approach poem is fit for the upper grades. This means that teachers across all elementary grade levels can incorporate this strategy and each grade can build on the next. Having each grade present their poems at a PTA [Parent Teacher Association] meeting is a perfect way to show off how our students are growing as scientists each year.

Conclusion

Utilizing poetry during science instruction is a pedagogically sound strategy based on poetry's historical relevance to science understanding from ancient to modern times. In this paper, we share a particular form of poetry selected because of its relevance to the nature of science as an inquisitive, creative, and social process. Action research findings from children's poems and reflections illustrate the appropriateness of this strategy for structuring children's knowledge gains about the world around them through observations and investigation. Consistent with the nature of

science as a creative endeavor, the templates provide guidelines to support children's creation of poems as a vehicle for sharing their findings, but the templates themselves are meant to be fluid, flexible, and adjusted to the variety of children's learning needs resulting from differences among children, as well as the diverse nature of the world around them.

Acknowledgements

The authors wish to thank poet Paul Fleischman for his inspirational Poetry in Two Voices upon which this work is based and Bulent Cavas, Peter Eastwell, Nicole Harvey, Debra McGregor, Jonathan Vos Post, Lesley Stanbury, and Bukky Yusuf for the thoughtful feedback they provided during their reviews of our original manuscript.

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Appendix A: A Series of Five Senses in Two Voices Poems Involving 2 Students (The text in italics was provided by the teacher)

Water

(by Lauren, Grade 1)

It's a liquid!	
	It's moving!
Is it wet?	Is it wet?
What do we see with our eyes?	
	Takes the shape of a bowl
What do we hear with our ears?	
	Drip!
What do we feel with our skin?	
	Cold
What do we taste with our tongue?	
	Like ice
What do we smell with our nose?	
	Nothing
I can drink it!	I can drink it!

Water

(by Allison, Grade 2)

It is a liquid!

It wiggles!

Is it hot?

Is it hot?

What do we see with our eyes?

Clear

What do we hear with our ears?

Splash!

What do we feel with our skin?

Cold

What do we taste with our tongue?

Wet

What do we smell with our nose?

Nothing

It's water!

It's water!

Cornstarch

(by Lauren, Grade 1)

It's snowing**!**

It's snowing**!**

Can we eat it**?**

Can we eat it?

What do we see with our eyes?

White

What do we hear with our ears?

Shh! Shh!

What do we feel with our skin?

Smooth

What do we taste with our tongue?

Old flour

What do we smell with our nose?

Dough

We can eat it!

We can eat it!

Powder

(by Allison, Grade 2)

I see smoke!	
	I see smoke!
Is it baby powder?	Is it sugar?[a]
What do we see with our eyes?	
	Dust
What do we hear with our ears?	
	Nothing
What do we feel with our skin?	
	Soft
What do we taste with our tongue?	
	Flour
What do we smell with our nose?	
	Dough
It's cornstarch!	It's cornstarch!

[a]Normally, the text on this line would be identical on the left and right sides of the page. However, this student wanted this line of her poem to consist of two different questions because she was equally concerned with both. Consequently, and as encouraged by the teacher, she altered the template to better fit her needs.

Goop

(by Allison and Lauren, Grade 1-2)

It's so gooey!	
	It feels weird!
Is it a solid?	Is it a liquid?[a]
What do we see with our eyes?	
	Looks like a lagoon
What do we hear with our ears?	
	Drip! Drop! Drip! Drop!
What do we feel with our skin?	
	Feels like a wet rock
What do we taste with our tongue?	
	Tastes like yucky dough
What do we smell with our nose?	
	Smells good
It's a solid!	It's a liquid![a]

[a]Normally, the text on both these lines would be identical on the left and right sides of the page. However, the 2 students wanted each other's ideas represented in the poem. Consequently, and as encouraged by the teacher, they altered the template to better fit their needs. To ensure that their audience could comprehend their poem while it was read aloud, the teacher visually displayed the poem on the overhead projector so that the audience could follow along.

Appendix B: A Scientific Approach in Two Voices Poem, Created by an Entire Class, With Dependent Variable Incorrectly Identified (The text in italics was provided by the teacher)

Soapy Seeds

(by entire fourth-grade class)

Radish!

Seeds!

Grow?

Grow?

What is our question?

Does soap affect the growth of a radish?

What is our prediction/hypothesis?

If more soap is added to the water, then the length of the seed[a] will be shorter.

What else do we need to know?

How many drops do we add?

How do we test our prediction/hypothesis?

Add different amounts of soap to the water cups and measure the length of the seed[a].

What are our results?

Our data matches what we predicted!

Eureka!

Eureka!

[a]Students later edited their poem for scientific accuracy by adjusting their dependent variable to length of the root.

Appendix C: Soap Solution Concentrations and Watering Instructions

Soap solution concentration (%)	Amount of liquid soap (mL)	Amount of water (mL)
0	0	100
10	10	90
20	20	80
30	30	70

Watering Instructions: We recommend that your class initially water each of their baggies with 15 mL of solution and continue to water each of their baggies with 10 mL of solution every third day. This class-wide schedule can be adjusted based on your classroom's environmental conditions.

Appendix D: A Scientific Approach in Two Voices Poem Created by a Small Group (The text in italics was provided by the teacher)

Mealworms: A Sticky Situation

(by Sarah, Jeannie, Jason, and Molli, Grade 5-6)

Meal!	
	Worms!
Worms?	*Worms?*
What is our question?	
	What can they climb?
What is our prediction/hypothesis?	
	If the surface is too slick, less little worms can do the trick. If the surface is rough, it's not too tough.
What else do we need to know?	
	Can they climb at all?
How do we test our prediction/hypothesis?	
	Place 4 on and let them climb!
What are our results?	
	Let's find out. On slick surfaces they do not succeed, but on rough surfaces they move with speed.
Eureka!	*Eureka!*

Appendix E: A Scientific Approach in Two Voices Poem Where Hypothesis is not Supported (The text in italics was provided by the teacher)

Ice Cream, You Scream

(by Adam, Sarah, Ann, Kate, and June, Grade 5-6)

Ice**!**	
	Scream**!**
AAAAAAA!	AAAAAAA!
What is our question?	
	Why does some ice cream freeze fast and some freeze slow?
What is our prediction/hypothesis?	
	If there is more fat in the milk, then it [the ice cream] will freeze faster.
What else do we need to know?	
	Will fat freeze?
How do we test our prediction/hypothesis?	
	Skim milk and whole, we're on a roll. Shake it like a Polaroid picture.
What are our results?	
	Prediction not supported. Let's do it again.
Do over!	Do over!

Appendix F: Suggested Recipe and Instructions for Making Ice Cream

Ingredients

120 mL (½ cup) milk, 10 mL (1 teaspoon) vanilla, and 50 g (¼ cup) sugar, granulated cane.

Instructions

1. Place above ingredients in a sealable, sandwich-sized bag and zip closed.
2. For extra protection, place bag inside another sandwich-sized bag and zip closed.
3. Put sandwich-sized bags inside a sealable 3.78-L (1-gallon) bag.
4. Add 110 g (6 tablespoons) of rock salt to 3.78-L bag.
5. Three-quarter fill the 3.78-L bag with ice and zip closed.
6. For extra protection, place bag inside another sealable 3.78-L bag and zip closed.
7. Shake and roll for about 15 minutes, wearing winter gloves to protect hands.

Notes

1. Check for food allergies in advance. Provide students who are allergic to any ingredients with a substitute. For example, fruit juice makes a delicious treat when frozen (do not add milk, vanilla, or sugar to juice).
2. Instruct students to wear goggles throughout the procedure.
3. Require appropriate hygiene practices by both teachers and students:
   a. Carefully wash hands with soap and water in advance.
   b. Do not share utensils or ice cream samples.
   c. Maintain personal work space.
   d. Clean classroom surfaces before and after class.

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