Science Activities, 47:35–40, 2010

ISSN: 0036-8121 print / 1940-1302 online
DOI: 10.1080/00368120903383133

Routledge
Taylor & Francis Group

Science Literacy Circles: Big Ideas about Science

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ABSTRACT Science literacy circles incorporate the organization of both science notebooks and literature circles to help K–8 students internalize big ideas about science. Using science literacy circles gives students opportunities to engage in critical thinking as they inductively develop understanding about science concepts.

KEYWORDS literacy and science, literature circles, science inquiry, science notebook, writing activities

Helping K–8 students understand the big ideas about science is a needed part of today's school curriculum. One way to accomplish this is to expand on students' natural curiosity about the world and their natural ability to communicate by blending the science notebook design and literature circles into science literacy circles. Teachers who have incorporated the science notebook design have increased student achievement in both science and literacy (Amaral, Garrison, and Klentschy 2002; Jorgenson and Vanosdall 2002) and using literature circles has led to increased comprehension and higher order cognition (Almasi 1995; Sweigart 1991). These achievements suggest that the science literacy circle, a constructivist teaching strategy and inductive inquiry method that can be incorporated into the science notebook, has the potential to maximize opportunities to increase science concept attainment.

SCIENCE NOTEBOOKS AND LITERATURE CIRCLES

Science literacy circles incorporate the organization of science notebooks (Klentschy 2005) and literature circles (Daniels 1994). Together they act as a powerful inquiry strategy for teachers to use. Science notebooks contain a comprehensive collection of students' work consisting of a reflection journal, laboratory write-ups, writing in multiple genres, class notes, and other learning artifacts that reflect stages of the inquiry process. The artifacts constructed for a science notebook represent how discussion, writing, and science data come together in a meaningful ways for students as they carry out the science inquiry process (Klentschy 2005).

Literature circles are small student-directed groups in which each group member agrees to read the same story, poem, article, or book and selects specific responsibilities to perform during the discussion (Daniels 1995). The responsibilities in literature circles are called "literature circle roles." For several examples

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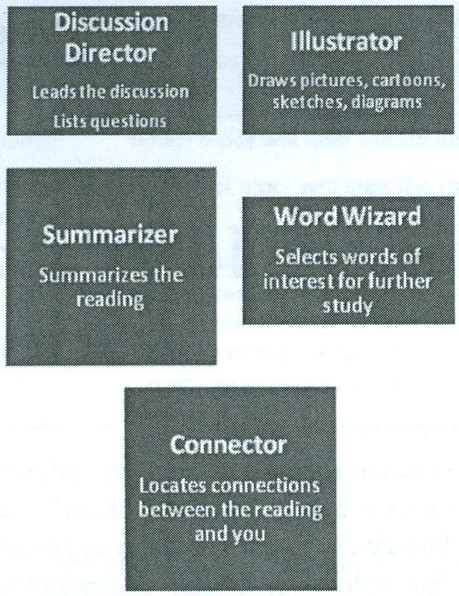

FIGURE 1 Sample literature circle roles.

of these roles (adapted from Daniels 1995; see Figure 1). Using literature circles encourages students to orally and graphically represent their thinking about the reading selection through the context of their role (Tompkins 2010).

Students are asked to represent their thinking through a variety of writing forms, such as journals, charts, diagrams, logs, and sketchbooks. The aim of using different writing forms is to help students focus their thinking to enable them to re-examine their thoughts and grasp new concepts. The value of the varied literature circle roles is to show students different ways to think about text. Both science notebooks and literature circles advance positive sociolinguistic environments and encourage the use of a variety of writing forms as vehicles to express thinking and learning.

SCIENCE LITERACY CIRCLES

Science literacy circles are student-centered inquiry circles to help K–8 students incorporate components of science notebooks and literature circles. Figure 2 illustrates how science literacy circles evolved from literature circles and science notebooks.

The inquiry steps included in the science notebook design and the roles of literature circles are merged to create science literacy circles. During a science literacy circle, students are asked to self-select a learning role to play as their group carries out each inquiry step of the circle.

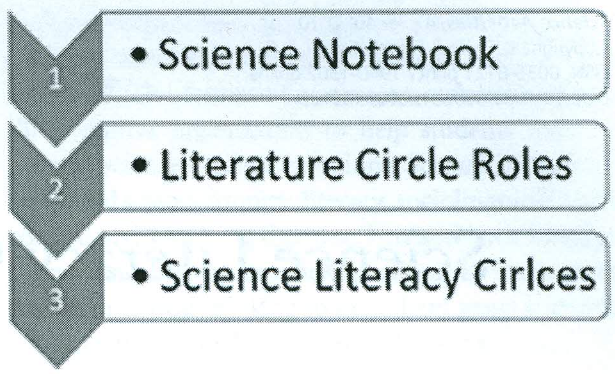

FIGURE 2 Developing science literacy circles.

Three Components of Science Literacy Circles

Science literacy circles contain three major components: science notebook organization, science literacy circle roles, and the student-generated artifacts and big ideas data chart. Figure 3 shows how the three components of science literacy circles are interrelated. Using science literacy circles in the classroom is an inductive-thinking instructional method. The three components of the circle happen simultaneously as each student inductively examines the concept and the whole circle strives to construct meaning by sharing moment-to-moment understanding of the science concept.

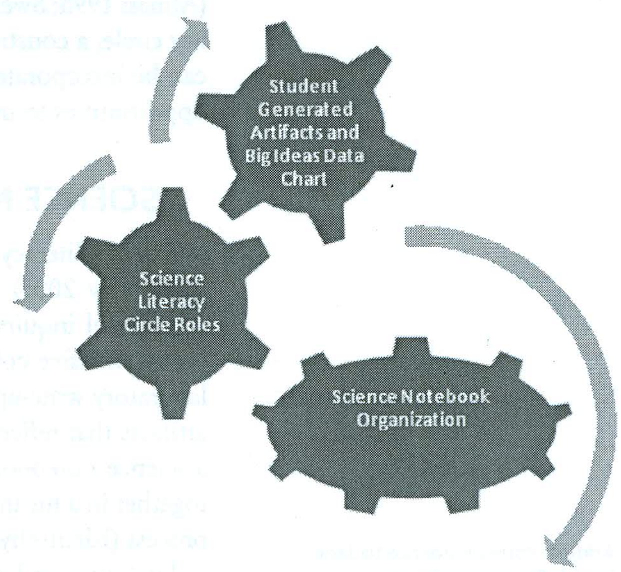

FIGURE 3 Components of a science literacy circle.

The Value of Each Role

The value of each student role is to provide a format in which the student can become a personal expert about a science concept. Discussion and using different writing forms are the ways to express thinking and correct misconceptions about the science concept under investigation. When students learn new science concepts, they may become overwhelmed with too much new information as they strive to fully understand each new concept. They are compensating for different levels of prior knowledge and different cognitive, social, and emotional developmental levels. Providing students with a clear role to follow as they investigate a new concept compensates for varying levels of prior knowledge and differing developmental levels, as does the support of collaborative learning groups.

Each self-selected role becomes a personal context for learning as the circle members participate in organizing their work in the science notebook. Each learner's purpose for the investigation depends on his or her role, and each role is a different filter for understanding and concept attainment. During a science literacy circle, the students are continuously creating meaning through discussion and the creation of personal writing activities, graphs, charts, and illustrations. The nature of a science literacy circle promotes the circular movement of ideas and questions shared by all group members through the perspective of their roles. All students are inductively striving to grasp the big ideas about science concepts.

Description of Science Literacy Circle Roles

The literature circle roles suggested by Daniels (1994) are standard, but there is always room to adapt the roles to fit distinct learning experiences (Miller, Kucan, and Dass 2007). Teachers will find that science literacy circle roles are adapted to provide new ways of thinking about each science concept presented for study. Each student role provides one dimension through which to think inductively about the science concept. The science literacy circle as a whole blends the students' inductive thinking to create the circle's big picture about the science idea.

The teacher's primary role during science literacy circles is to introduce a new concept, present any prior knowledge needed to promote understanding, introduce the materials and procedure, address any unfamiliar vocabulary words, and act as a knowledge facilitator. The student roles require access to materials that can be used to create artifacts that represent students' level of understanding. Pens, pencils, crayons, markers, white and colored paper, scissors, glue, and index cards are examples of some useful materials.

The adapted science literacy circle roles illustrate different dimensions of understanding that link to a variety of elementary science concepts. Each role's responsibility is developmentally appropriate for elementary students and can be easily modified by each teacher to meet individual student needs. Figure 4 provides examples and description of the different roles.

The inquiry organizer is a peer guide who scaffolds fellow students through a script of prompts that are used to guide the circle. The following are examples of script prompts:

- Title and focus questions: What is the purpose of this investigation? What questions do I have?
- Hypothesis: What do I think will happen?
- Procedure: What steps will be followed?
- Materials: What materials will I need?

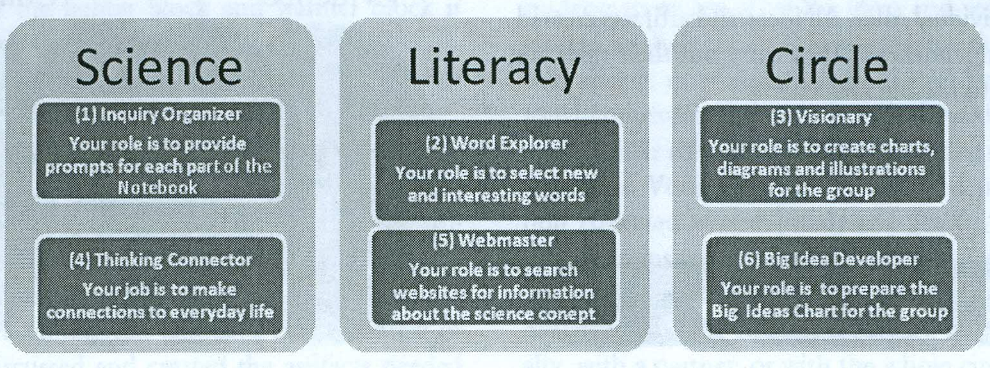

FIGURE 4 Science literacy circle roles.

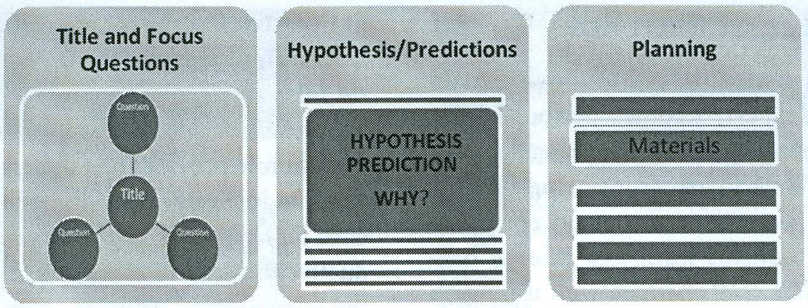

FIGURE 5 Science literacy circle big ideas charts prepare students for the investigation.

- Observations: What am I observing?
- Conclusions: What have I learned?
- New ideas and questions: What are my new ideas? What are my new questions?

The word explorer's role is to locate the circle's familiar and unfamiliar vocabulary. Vocabulary can be placed on a science word wall or on word cards. Further study of vocabulary could include the creation of science vocabulary circle roles (Miller, Kucan, and Dass 2007) to provide a format for science vocabulary attainment. The visionary's role is to create charts, diagrams, and illustrations in collaboration with the circle members. The thinking connector's role is to talk with the circle about possible connections between the investigation and everyday life. This role provides the link between prior knowledge and the new science concept. The Webmaster's role is to partner with different circle members to search the Internet or locate additional reading material to find any information needed to facilitate concept understanding. Each of the roles provides a level of engagement for students to create personal artifacts of learning. The big idea developer completes the science literacy circle big idea data charts in collaboration with the other students as they carry out their individual roles. All ideas and artifacts created by individual students as they carry out their roles are integrated into the big idea charts.

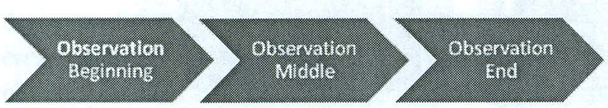

FIGURE 6 Observations: beginning, middle, and end chart.

Student Artifacts: Big Ideas Science Data Chart

Fourth- and fifth-grade students attending an after school program at the Victoria, Texas, Boys and Girls Club participated in a science literacy circle about the conduction of matter. The science concept was introduced using Amazing Melting Ice Blocks (available at http://www.teachersource.com/Energy/Thermodynamics/AmazingIceMelingBlocks.aspx).

Big ideas science data charts (see Figures 5, 6, and 7) guided the circle members as they investigated the conduction of matter. Students used a variety of writing forms to facilitate concept understanding, because written communication is one of the most important forms of communication in science to translate concepts, procedures, results, and conclusions (Robertson 2005), and to help students think and express their ideas about science content.

The first three big ideas charts, shown in Figure 5, prepared the students to carry out their investigation by providing purpose, motivation, and activation of prior knowledge connected to the science concept. Each student prepared for the investigation in the context of his

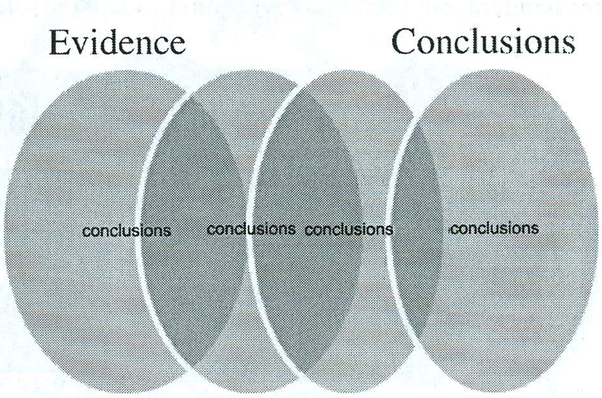

FIGURE 7 Conclusions semantic map.

or her role by discussing and creating artifacts about the circle's questions for the science concept under investigation. Building a semantic map provided an avenue for the students to link their questions and develop the title of the lesson. The students generated a variety of questions and titles that were collected by the big ideas developer. The following are examples of the different types of questions and titles generated.

Questions:

- Which block will melt the ice faster?
- Which ice cube will melt faster?
- Which block is an insulator or a conductor of energy?
- Which ice cube will stay solid?
- Which block is colder?

Titles:

- Ice on Ice Block
- Ice Melting
- The Ice Crusher
- Ice Invaders

Once the titles and focus questions were determined, the students, in their respective roles, began to synthesize a hypothesis. Through an inquiry process viewed through the lens of the individual's role, each student constructed a hypothesis. The hypothesis had to contain a prediction that would help initiate science investigation. The students generated a variety of predictions based on the questions and titles. All hypotheses were recorded by the big idea developer. The following are some of the hypotheses the students generated.

Hypotheses:

- The metal block will melt faster because it produces more heat.
- The ice on the lighter block and warmer block is going to melt the ice faster.
- The cold block will melt the ice faster than the hot block.
- One block will melt the ice cube faster.

Planning the steps of the investigation required students to follow a sequence of events to determine answers to the questions and evaluate whether or not the hypothesis is accurate. The students, in the context of their roles, discussed and created the artifacts needed to design a plan to conduct the investigation. The big idea developer listed the steps of the investigation that had been developed by all of the circle members.

While learners were making observations during the inquiry process through the point of view of their roles, they were simultaneously inferring meaning and using a variety of writing and graphic representations to communicate their findings. Written descriptions included sensory observations such as color, shape, and size. Observations included a comparison of the observation to something similar or different; analysis of the observations, including why the phenomenon occurred; application of the knowledge such as how the observation is used in everyday life; and reasons to support the big ideas.

The big idea developer compiled the observations with data collected by the students and created the beginning, middle, and end observation chart. All of the students' observations indicated that the ice cube on the colder-feeling metal block turned into water faster than the ice cube that was on the warmer-feeling plastic or wooden block, although at first some students had predicted that the colder feeling block would melt the ice slower. Their supporting reason for why the colder, metal block melted the ice cube faster was that there was a greater transfer or conduction of energy from the metal block to ice than from the plastic block to the ice cube.

During the conclusion portion of the science literacy circle, each student, in the context of his or her role, drew conclusions and sought to develop new knowledge based on the evidence. To communicate this information, each student used discussion and created written artifacts. This process was reflective as students, through the perspective of their roles, asked the following questions: Has the hypothesis been proved or disproved? Why, or why not?

The conclusion journal provided an opportunity for students to review all of the ideas and written artifacts created by their circle. This was the revision portion of the process, in which students moved from their personal context for learning as experienced through the eyes of their roles to a global view of the entire circle's responses. Vocabulary was readdressed; new information collected was revisited; and graphs, illustrations, and diagrams were re re-examined (see Table 1).

During the creation of the conclusions journal, circle members had the choice to create a journal individually, with a partner, or with the whole circle. To create the conclusion journal, each student reviewed the big

TABLE 1 Ice Terminators Transfer Energy: Conclusions Journal

Category	Example
Question(s)	Which block will melt the ice faster?
Predictions or hypothesis	The metal block will melt the ice faster.
Conclusions	The ice cube melts faster on the metal block because the power from the metal block transfers or conducts energy to the ice cube to make it melt faster. It conducts heat better.
New question(s) or idea(s)	What else conducts energy faster?

ideas data chart and all the artifacts created by members of the circle. In the writing revision process, students extended their understanding of scientific ideas and transformed these ideas to deepen their understanding of scientific concepts.

REFLECTIONS

The purpose of science literacy circles is to help students grasp big ideas about science concepts within both an independent and social learning community. The role each student carries out provides opportunities to view the science investigation from an individual point of view that ultimately is shared with the entire circle. The format of a science notebook provides the cognitive organization to help students seek answers to science concept questions. Science literacy circles blend science inquiry, literacy, sociolinguistics, and constructivist learning theories. This authentic blend of science and literacy experiences allows all students to engage in critical thinking to help them grasp scientific concepts in personal and meaningful ways.

REFERENCES

Almasi, J. F. 1995. The nature of fourth graders' sociocognitive conflicts in peer-led and teacher-led discussion of literature. *Reading Research Quarterly* 30: 314–51.

Amaral, O., L. Garrison, and M. Klentschy. 2002. Helping English learners increase achievement through inquiry-based science instruction. *Bilingual Research Journal* 26: 213–39.

Daniels, H. 1995. *Literature circles: Voice and choice in the student-centered classroom*. Portland, ME: Stenhouse.

Jorgenson, O., and R. Vanosdall. 2002. The death of science? What we risk in our rush toward standardized testing and the three R's. *Phi Delta Kappan* 83: 601–05.

Klentschy, M. 2005. Science notebooks essentials. *Science and Children* 34: 24–17.

Miller, L., L. Kucan, and M. Dass. 2007. Literature circles roles for science vocabulary. *The Science Teacher* 74: 52–54.

Robertson, B. 2005. Science 101: What writing represents what scientists actually do? *Science and Children* 43(3): 50–51.

Sweigart, W. 1991. Classroom talk, knowledge development and writing. *Research in the Teaching of English* 25: 469–93.

Tompkins, G. 2010. *Literacy for the 21st century: A balanced approach*. 5th ed. New York: Pearson.