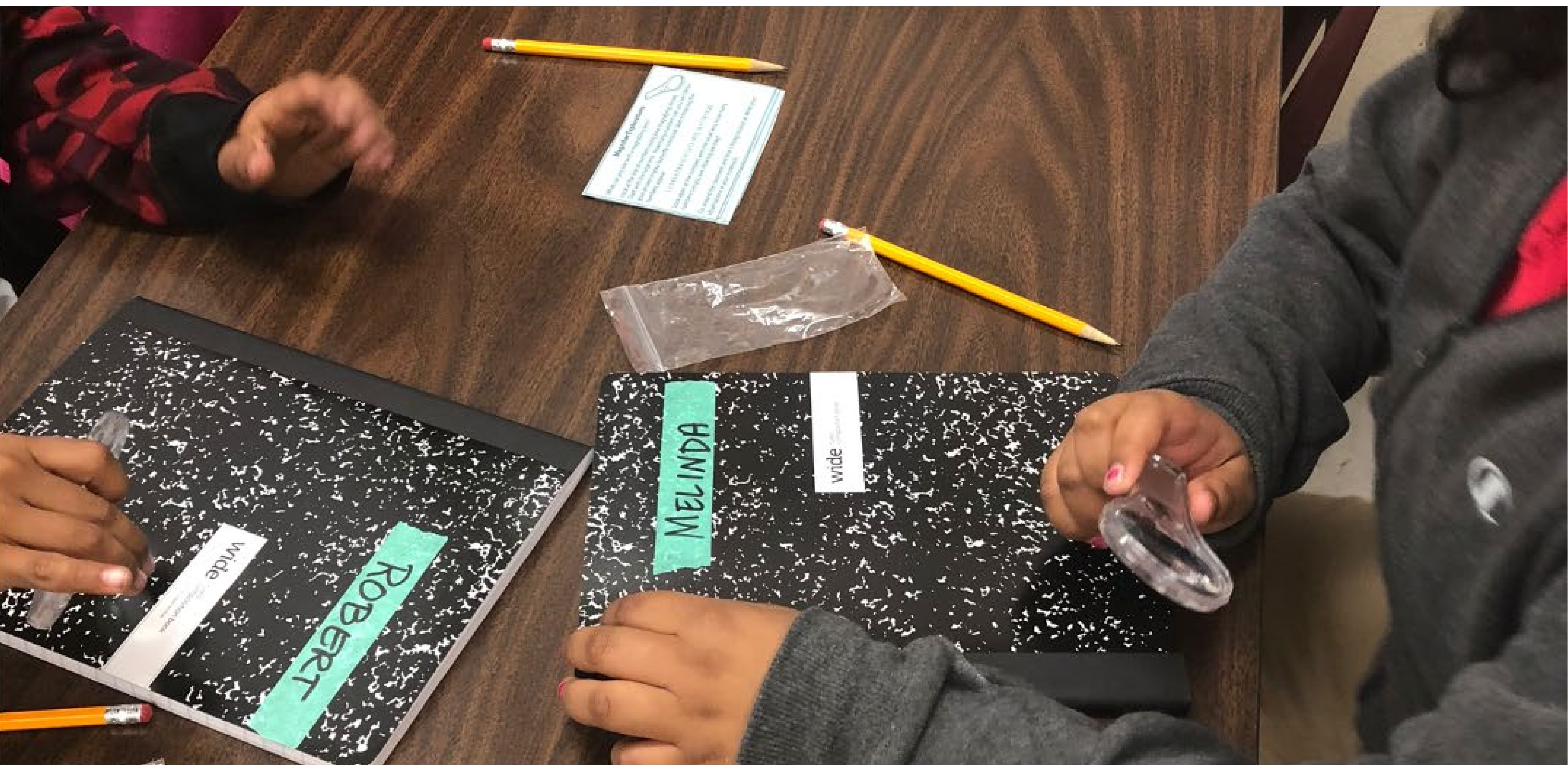
OVERVIEW GUIDE FOR TEACHERS

Authentic Literacy and Language for Science



Supporting Disciplinary Literacies for Science

BioEd

STEM Teacher Resources
from Baylor College of Medicine

Overview Guide for Teachers
Authentic Literacy and Language (ALL) for Science

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STEM TEACHER RESOURCES FROM THE CENTER FOR EDUCATIONAL OUTREACH AT BAYLOR COLLEGE OF MEDICINE

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1. INTRODUCTION TO *ALL for Science*

1.1. What is ALL for Science*?*

Authentic Literacy and Language for Science (*ALL for Science*) is a curriculum framework designed to support students' learning of true-to-life language of science and scientists while participating in inquiry-based science activities. The framework is designed to promote both science sense-making and language sense-making through three aligned components, which are shown in the figure below:

Together, the three components are designed to authentically engage students in how scientists use language, while building students' science knowledge and skills. This guide will introduce you to the framework, its components, and recommendations for its implementation.

1.2. STEM and Science Learning

The acronym STEM stands for "science, technology, engineering, and mathematics." It often refers to any educational program, teaching activity, or curriculum that includes at least one of the four component subject areas. However, STEM can also be thought of as *an interdisciplinary approach to teaching and learning in which science and other skills are presented or taught holistically, without separating discipline-specific content, and make connections among individuals, school, community, and the world through authentic problems or topics.*[1]

Early STEM experiences develop students' interest and knowledge and contribute to later success in science-related careers.[2] Yet, many students to do not have access to authentic science-learning practices that encourage them to persist in STEM-related coursework or envision themselves in the roles of STEM professionals.

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[1] Moreno, N. 2018. Strengthening Environmental Health Literacy through Precollege STEM and Environmental Health Education. In Finn, S, O'Fallon L (Eds.), *Environmental Health Literacy*. New York: Springer. pp 165-193.

[2] Maltese A, Tai R. 2010. Eyeballs in the Fridge: Sources of early interest in science. *International Journal of Science Education* 32(5): 669-685.

Being able to read, write, listen, and speak using the language of science and the other STEM fields is key to students' success in these areas for several reasons. Language can help students develop their identities as members of the science community. Identity development, in turn, may influence decisions to pursue science-related courses or careers. Along the same lines, students who are effective readers and writers in the context of science may be more likely to persist in science.[3] [4] This project weaves hands-on science learning with English language arts so that students develop skills and habits of mind that reflect how scientists communicate and solve problems in the real world.

1.3. Language and Communities of Practice

In many ways, language can be the gateway to membership in a particular group. For example, scientists make new words to represent complex ideas, ask questions to guide their work, and pay attention to details. By learning to use language as practicing scientists do, students become fluent with the discipline of science. In other words, they develop disciplinary literacy. Using language as a scientist is an important step toward becoming a member of the scientific community.

ALL for Science seeks to facilitate student participation in the community of scientists by embedding authentic use of science language in lessons focused on the teaching of both literacy and science in a typical school day. The framework enables teachers to engage students seamlessly in science learning through authentic use of science language. At the same time, by empowering students to communicate as scientists, we hope to help them envision themselves in science or STEM-related career pathways.

1.4. Organization and How to Use This Approach

ALL for Science provides a bridge for teachers to connect English language arts (ELA) teaching and learning—with particular focus on the use of expository texts and research—to science inquiry. In the process, we expect students to develop literacy skills related to science as a discipline. We have built the program around a daily schedule, with each day consisting of an ELA mini-lesson designed to support student group work on a text-based research question, followed by a hands-on guided inquiry experience on related science topics.

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[3] Zhai J, Jocz J, Tan AL. 2014. 'Am I Like a Scientist?': Primary children's images of doing science in school. *International Journal of Science Education* 36(4): 553 ---576

[4] Shanahan T, Shanahan C, 2012. What is disciplinary literacy and why does it matter? *Topics in Language Disorders*, 32(1), 7-18.

The model for each day has the following three components:

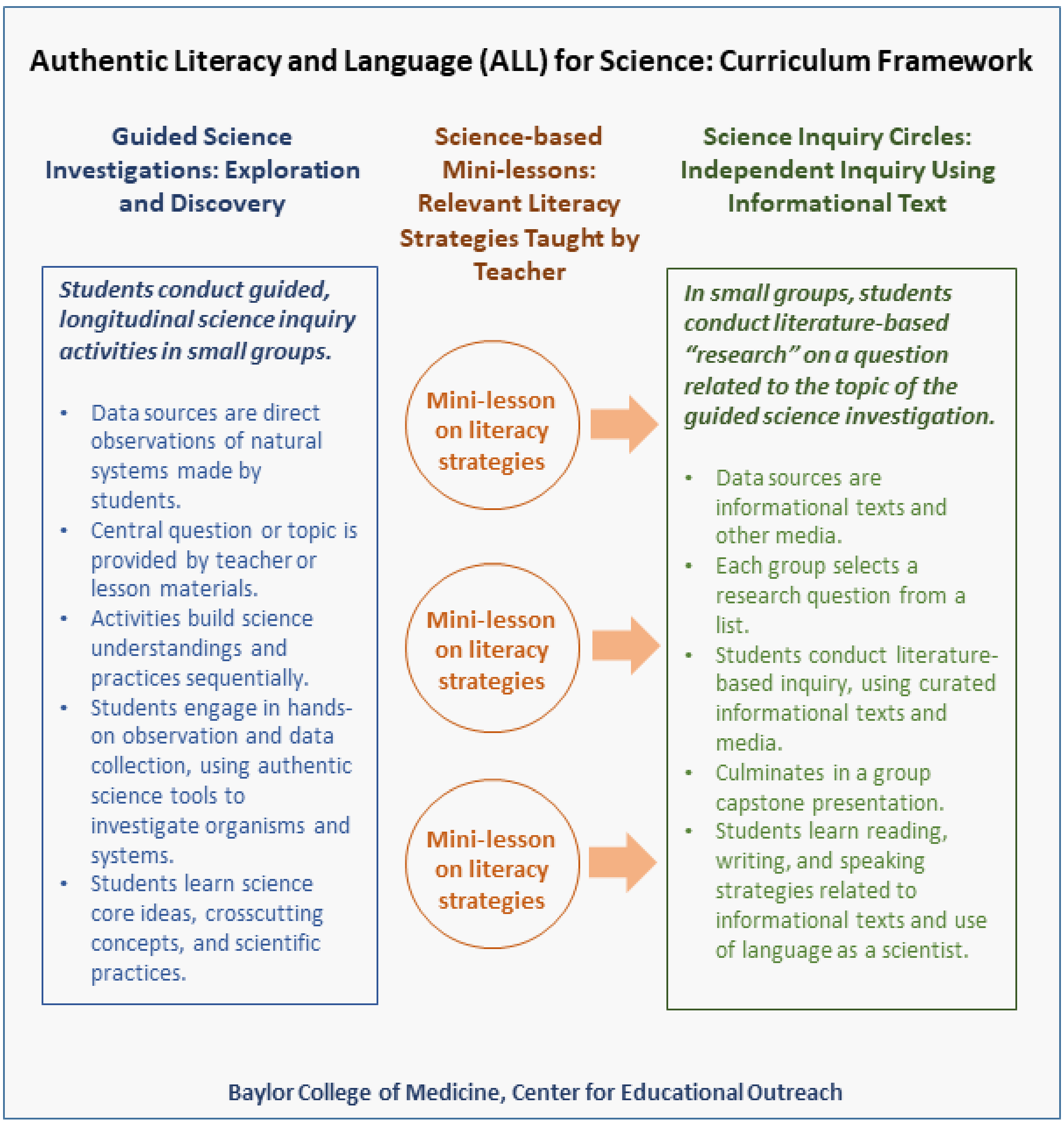
- **Guided Science Investigation***.* Science inquiry activity in which the teacher facilitates and guides students, who work in small groups on a hands-on science exploration based on a model organism or system.
- **Science-based Mini-lesson ("mini-lesson")**. Whole-group mini-lesson that focuses on a reading strategy relevant for use with science expository texts or media.
- **Science Inquiry Circle ("inquiry circle")**. Small, guided inquiry circle groups in which learners apply and practice their reading strategies to their own text-based research on science topics related to the overall theme of the unit.

In the first component (Guided Science Investigation), children are guided by their teacher in a facilitated hands-on science exploration based on a model organism or system. This is where children engage in the practice of hands-on science inquiry just as if they were in a lab with other scientists. Research on the importance of guided science investigations suggests that these hands-on investigations not only help develop scientific concepts in children, but also cultivate positive feelings associated with science. Each guided science investigation activity contains a section titled "Background Information," with details and guidance to aid in your understanding of the concepts covered. These sections are intended for teachers only and should not be used as part of direct instruction with the learners.

In the second component (Science-based Mini-lesson), children are engaged in a science-based literacy strategy that is relevant for use with scientific, expository, and web-based texts and multimedia texts. It is during this part of the framework that children have access to intentional instruction—where their teacher co-constructs an understanding of specific reading strategies that will help them read, write, speak, listen, and think like scientists as they read and produce scientific texts. Research on this component suggests that successful teachers of comprehension instruction provide opportunities for their children to engage with reading strategies while also helping children discover the "secrets" (or the underlying processes) of reading strategies.

The third component (Science Inquiry Circles) involves small, text-based research groups. Similar to guided reading groups, inquiry circles are an important part of the framework, as they provide a much-needed space and place for children and youth to interact with and create their own scientific texts. The scientific texts are a complement to the guided science investigations: they support the same conceptual development taught in the guided science investigations (e.g., heredity and life cycles, interdependence among organisms, producers in an ecosystem), but they also provide a text-based opportunity for children to continue to develop an understanding of the concept under study. Science inquiry circles are the place where children put into practice the science-based literacy strategies they learn during the science-based mini-lesson while providing ongoing opportunities to circle back through previously learned science-based reading strategies.

The three daily sections are connected by each unit's overarching topic. You may teach the literacy and science lessons separately throughout the day or back-to-back during a large block of time. For example, the science-based mini lesson and science inquiry circle groups can be conducted in the morning during the reading and language arts block, and the guided science investigation activity can occur in the afternoon. The following diagrams illustrate the various components of the model:



A note about the lessons: We believe teachers know their learners best and are experts in their fields. Therefore, while we provide suggested statements you might use during each day's lesson, we emphasize your freedom to employ language that works best in your classroom for your learners. You may see the phrase, "Say something like . . . " throughout the lessons as an invitation to adapt the language of the lesson to meet your needs.

1.5. Additional Online Resources on BioEd Online

All curricular units developed using the *ALL for Science* framework—and suggestions for resources to implement them—can be found on the project pages on www.BioEdOnline.org.

Within their inquiry circles, students select a topic or question to investigate using high-quality informational texts or media resources. Learners then choose the resources from which to collect information related to their question. You may use print materials in the classroom and make them available in a central place for students or have students access resources online.

For students who are working online, we provide links to a variety of media that will be valuable for their research. We include websites, videos, ebooks, virtual tours, and interviews with experts. Please be advised that some of the websites have advertisements; consider using websites like SafeShare.TV and ViewPure.com to remove the ads.

If you are using websites for students' research, we recommend checking in advance to ensure that the websites work within your school/district firewall. We have also included YouTube videos. You can find the suggested ebooks on GetEpic.com and sign up for a free account with learner access codes. Parents are eligible for free trial accounts if students are working from home or if your district is not a subscriber. You can access links to virtual tours for some ecosystems or organisms, as well as the names of experts who can be interviewed via SkypeAScientist.com. Additionally, we encourage you to use resources already available through your district, such as Encyclopedia Britannica, Pebble Go, or Brain Pop.

2. THE CYCLE OF INQUIRY

2.1. Inquiry as a Process

As noted in the National Science Education Standards, learning science is best accomplished by active participation in scientific inquiry.[5] Even very young children can build knowledge by asking and seeking answers to questions about the world around them. The Next Generation Science Standards (NGSS) explicitly acknowledge the curiosity of all children and the importance of leveraging that curiosity to promote science learning.[6] The guiding principles of the NGSS are listed below:

- **Children are born investigators**. Children naturally seek to understand and influence the world around them, and their early ideas about how things work can be used as a foundation for teaching science.
- **Focusing on core ideas and practices**. A framework for science learning should focus on key (or, core) ideas and on the basic practices and approaches used by scientists and engineers in the real world.
- **Understanding develops over time**. Core ideas should be developed over time through learning progressions, which provide instructional supports to help students progress toward mastery.
- **Science and engineering require both knowledge and practice**. Scientists use inquiry and problem-solving approaches to develop explanations and predict future outcomes. Engineers aim to solve problems related to a human problem or need.
- **Connecting to students' interest and experiences**. Science learning should connect to students' everyday lives and link to future potential careers.
- **Promoting equity**. All students should have access to quality teaching, resources, and time to learn science effectively and engage in activities that inspire further participation in science.

Scientists use information from first-hand observations, experiments, and explanations and observations by other scientists. This information is contained in expository texts, graphs and tables, maps, photographs, videos, and other forms of media. *ALL for Science* enables students to use resources such as these to extend and deepen their understanding in ways similar to those used by practicing scientists.

[5] National Research Council. 1996. *National Science Education Standards*. Washington, DC: The National Academies Press.

[6] NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

2.2. Teacher as Facilitator of Active Learners

The teacher's role in guided inquiry is to model and facilitate learner-driven exploration, research, and discovery. Once you have piqued your learners' interest, they must take an active role in their own learning. Inquiry groups should explore and learn through investigation while the teacher guides them by asking open-ended questions and encouraging further exploration. Once the learners have concluded their investigations, teachers may extend student learning by providing relevant information and encouraging students to share and justify their findings.

2.3. Using the 5E Approach for Science Investigations

We employ a learning cycle approach to develop students' science knowledge. This approach, referred to as the "5E" model, has been refined and disseminated by BSCS Science Learning.[7] Elements of the 5E learning cycle are listed below:

- **Engage**. Students are presented with a question, an interesting example, or a problem. This phase connects students' past and present experiences and enables the teacher to estimate learners' prior knowledge, identify misconceptions, and stimulate interest in the learning experiences that will follow.
- **Explore.** Students participate in actual experiences with physical materials, representations of data, or media. Students may do experiments, collect data, make observations and connections, and ask questions. Students usually work in groups, with the teacher acting as a coach or facilitator to guide students as they conduct the investigations themselves.
- **Explain.** Students begin to make sense of their data, describe their observations, and develop their own explanations. Students listen to other learners' explanations and defend their own. The teacher's role in this phase is to ask appropriate questions, guide students (to include addressing misconceptions), and direct them to helpful resources.
- **Elaborate.** Students use the information they have gathered to propose solutions and apply what they have learned to new and different situations. The teacher's role is to help students extend their ideas to reach a much broader conclusion than the one they derived initially by conducting their own investigations.
- **Evaluate.** Students judge their own learning progress. Teachers may also evaluate students' knowledge or skills development. If necessary, teachers may develop alternate assessment strategies to help students focus on new information and understand the lesson in greater depth.

[7] Bybee R. 2010. *The Teaching of Science: 21st Century Perspectives*. Arlington, VA: NSTA Press.

For more information about applying the 5E learning cycle approach to teaching science inquiry, please watch the video at the following link:

http://www.bioedonline.org/videos/supplemental-videos/5e-model-for-teaching-inquiry-science/

2.4. Texts that Support Science Learning

As noted above, scientists use language in a variety of ways. Written language is especially important for recording and reporting findings and for learning from the work of other scientists. Below are three important ways in which young students employ texts in science learning:

- **Science Notebooks.** Science notebooks are “thinking tools.”[8] Students use their notebooks to record observations, notes, measurements, questions, and information from additional sources. The notebooks encourage students to use writing to organize and document their ideas and reflections. As such, they also document student learning to the teacher. Classroom science notebooks replicate the work of scientists, who meticulously record their methods, data, observations, and interpretations. Notebooks enable scientists to repeat their investigations and form the basis for communications about their findings. There are a number of ways to organize student science notebooks. Students will set up and use notebooks as part of their activities in this unit. More information can be found at the following links:

  https://www.calacademy.org/educators/setting-up-your-science-notebooks
  https://www.youtube.com/watch?v=Ti3nUDNK8iA

- **Informational Texts.** Written materials, such as nonfiction trade books or science websites, support students’ science learning and develop their language skills and vocabulary development. Scientists rely on informational texts to learn from the findings and experiences of other scientists.

  Similarly, informational texts provide background for the open-ended research projects that students will carry out in their inquiry circles. The informational text resources available on the *ALL for Science* website have been evaluated favorably for accuracy and quality by our team.

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[8] Gilbert, J, Koteman M. 2005. *Five Good Reasons to Use Science Notebooks*. https://www.nsta.org/publications/news/story.aspx?id=51160

- **Interdisciplinary Texts.** Scientists use a variety of visual strategies to make sense of their observations. Sometimes, it is sufficient to organize information in the form of a table. In other cases, a graph or a more complex diagram is needed to elucidate relationships among different kinds of variables. A bar graph, which uses columns to compare measurements or counts, can make it much easier to interpret information. The following NASA link provides basic information about using the information in graphs: https://climatekids.nasa.gov/graphs/

2.5. Students Groups and Guided Science Investigations in the Classroom

We recommend that students work together in groups of four for their guided science investigations. Usually, heterogeneous (diverse) groups are most effective. However, working in groups does not necessarily imply that students will cooperate effectively to achieve their individual or collective goals. Even the process by which members are assigned to groups can affect many aspects of a team project. Here are some general factors to keep in mind when deciding how to configure groups:

- Students' shared interest in a topic
- Students' prior knowledge of or experience with a topic
- Students' motivation to work independently
- The diversity of perspectives brought by students

Within their groups, students will have different defined roles. The four members of each group will rotate roles so that they have a range of experiences. Consider having students rotate jobs once per week. Job badges and wall posters are included with unit materials. Establishing a cooperative model for learning in the classroom helps students conduct science explorations in an organized, effective manner.

You will notice that the "job" descriptions for each role differ from the typical cooperative group titles used for science teaching. The roles used in the *ALL for Science* framework are aligned with typical science positions in the real world.

Cooperative Group Roles for Science

Lead Scientist	Lab Director	Data Scientist	Equipment Director
• Asks the questions and builds consensus related to the wording of the questions. • Guides the work of the team by reading directions. • Keeps the group focused on the investigation. • Checks the work of the team.	• Gathers materials for the group. • Reminds the team to follow safety rules. • Leads the discussion about the observations and the results. • Encourages the group members to participate in the research.	• Records observations and data gathered. • Leads the team in making charts or posters. • Tells the teacher when the group is finished. • Explains the results to the class.	• Picks up the materials. • Operates or helps other team members use the equipment. • Asks the teacher any questions of the team. • Returns the materials and directs clean-up.

Please watch the video below for more tips on setting up cooperative student groups:

http://www.bioedonline.org/videos/content-presentations/tools-and-techniques/cooperative-grouping-ideas-for-effective-classroom-practice

2.6. Live Animals in the Classroom

Studying living organisms in the classroom inspires students and allows them to develop skills related to stewardship, appreciation of the natural world, and observation. Some *ALL for Science* units allow students to care for and observe producers, such as freshwater algae, or common invertebrate organisms, such as painted lady butterflies. Before beginning a unit, confirm whether your school or school district has specific guidelines about live invertebrate organisms in the classroom.

Painted lady butterfly pupa (*Vanessa cardui*).
Image: Harold Süpfle, Creative Commons, 2009.

Living organisms usually need to be ordered or collected and grown a few days before beginning a unit. Directions for the care of the specific live organisms are included in individual activities within each unit.

Students should be instructed in the humane care of animals and should observe care in making observations or transferring organisms. Classroom animals should not be released into the wild. They can be kept in the classroom, donated to a nature center, or given to a responsible student, with parental permission.

2.7. Products to Communicate and Celebrate Learning

Scientists communicate their work and findings to peers and the general public through outlets such as written scientific articles or papers, articles for general audiences, letters, books, verbal presentations, 3–5 minute "lightning talks," videos, posters, blogs and television, and newspaper or radio interviews. Typically, the work of scientists goes through a process known as peer review. During peer review, other scientists read, discuss, and provide feedback to the authors. Peer review guides the work of scientists and improves the overall quality of published scientific work.

Consider conducting a class scientific poster session to enable students to demonstrate their science learning and project findings. During the session, students from each group will explain their poster to other students, who circulate around the room. Allow half of the members of each team to stand with their posters, while the other members circulate. Then, have students switch roles so that all students can view the posters of other groups. Encourage students to ask questions and comment on the work of other groups.

3. READING AND WRITING STRATEGIES TO SUPPORT SCIENCE INQUIRY

3.1. Introducing Science Inquiry Circles to Children: The Role of Texts in Science

While we do not want to script or prescribe how to implement science inquiry circles, there are some suggestions to discuss with your children before they embark on the science inquiry circles themselves. Texts play an important role in science. You might want to have a conversation with children about the role of texts (print-based, web-based, and multimedia) in the daily work of scientists. While hands-on science investigations do drive the work of scientists, they also read and write scientific texts on a daily basis. Scientists also talk with other scientists about what they are reading and writing.

Types of texts used in science. While there are some similarities to the types of texts used by scientists and other professions, it is important that children understand the ways in which scientific texts are unique. Scientists use print-based texts, multimedia texts (e.g., videos, audio), and web-based texts (e.g., websites authored by credible sources).

Scientists often use informational texts to see what other scientists have said or written about the topic they are studying. A scientist might go to the library and check out a book on the migratory patterns of butterflies. Or, they might read this information in a scientific article published in journals that only scientists read. While someone from another profession may pick up this journal and read the report, it is unlikely that they would be familiar with the journal. But scientists know about the journal and where to find books about their topic in a library. Other professions have books and journals specific to their fields too.

Text features in scientific texts. Just as it is important that children know of the different types of texts used by scientists, it is important that children understand the ways text features appear and are found in scientific texts. Headings, subheadings, visuals with captions, tables of contents, glossaries, indices, and special text such as bold or italicized words are all examples of features that might be found in scientific texts.

Structure of scientific sentences. While it is not imperative that children understand the structure of scientific sentences (e.g., grammatical usage of words) early in their experiences as young scientists, it is important that they understand that scientists have an agreed-upon way of structuring how they present what they know and have discovered in their investigations. For example, when writing their scientific report or sharing what they discovered with other scientists, they are expected to summarize and synthesize the findings of other scientists, and write their research report with clarity and precision, and use words that their field has agreed on. Scientific writing avoids metaphorical, ambiguous, or “flowery” language, all of which are often used by literary writers. Scientists also use words that are highly technical and semantically accurate and precise.

Several reading and writing strategies are unique to reading and writing like a scientist. There are also generic reading and writing strategies that transcend various disciplines, including English Language Arts/Reading (ELA/R) and science. The model we describe in this *ALL for Science* guide capitalizes on both types of strategies and addresses several ELA/R strategies that support science learning. The reading strategies presented support word identification/knowledge strategies, ongoing comprehension strategies, and fix-up strategies. These strategies support the three cueing systems that readers use when they read.

3.2. Routines of Text-based Inquiry

Scientists often engage in routines as part of their practice, including routines that involve working in teams and working with texts. While these routines have a structure to them, routines do change (both in the moment and over time) as a result of changing needs of the researcher, who comes into their learning spaces or classrooms, and the texts they are using (both reading and creating). Here are some routines that will be helpful to establish in your classroom:

1. Use the mini-lesson as a bridge between the guided science investigation and the science inquiry circles. Specifically, support the scientists in seeing how the strategies they are learning are part of the scientific process and how they relate to the text-based inquiry they will do during inquiry circles.
2. As children are transitioning from the mini-lesson to their inquiry circles, have one person (the Equipment Director) gather materials; all others can move to their circle groups.
3. Begin inquiry circles by briefly outlining the goals for the time period (e.g., “Today you’ll make your inquiry charts, brainstorming the questions you’re trying to answer, and identifying your resources”).
4. The scientists use the resources (text- and media-based) to locate answers to their questions at the top of their inquiry charts.
5. The teacher rotates between groups, providing support. This support may take different forms. In some cases, the teacher might need to support the use of disciplinary literacies (e.g., evaluating claims) as well as generic reading strategies (e.g., monitoring comprehension and fix-up strategies, summarizing).
6. Because scientists are working both individually and with others in their inquiry circles, there should be a constant “hum” of the scientists reading with each other, documenting what they are reading, and discussing the information with each other.

7. At the end of the allocated time, each group should put away their materials and resources. The Equipment Director will return the materials to the allocated space.
8. End the inquiry circles by debriefing the work of the groups. The following might serve as topics for debriefings:

    a. What science-based literacy strategies did you use in your inquiry circles?
    b. How did you support each other in your inquiry circle?
    c. What challenges did you encounter?
    d. What will you work on tomorrow (or the next day) based on what you did today?

3.3. Components of the Science Inquiry Circles

While the components of the science inquiry circles are unique to each classroom, there are a few overarching components that are needed for children to be successful in their text-based inquiry projects. We outline them here and provide a brief overview of each component.

1. **Forming inquiry circles.** Inquiry circles should ideally form around children' shared interests. You will need a system for forming interest-based circles. One way you could do this is to have children rank their first, second, and third choice of inquiry topics. Then you can negotiate groups of reasonable size and composition in which children are researching a topic they are excited to read about.
2. **Assigning roles.** You may choose to assign roles or support children in selecting their roles within the team. These roles are the same as those used in science investigations (Lead Scientist, Lab Director, Data Scientist, and Equipment Director).
3. **Asking inquiry questions.** You will want to discuss questioning with children and help them avoid questions that can be answered with a "yes," "no," or numerical answer. Good inquiry questions are big questions that take time to answer. One strategy for selecting inquiry questions is to have children brainstorm many questions in their groups and then narrow down to a smaller number of high-quality questions.
4. **Creating inquiry charts.** Inquiry charts are designed to support children in organizing their research. Research questions are recorded across the top of the inquiry chart and sources are listed down the side. This forms a grid where scientists can systematically record their research. Children will most likely be using their inquiry charts every day, so consider how you might organize and store the inquiry charts so that they are accessible.
5. **Researching with text.** Texts that children might use for research include trade books, ebooks, websites, and videos. Children will be researching their inquiry

questions using a variety of texts. They will be recording their findings and their sources on their inquiry chart. See Selecting Texts for Inquiry Circles below for more information.

6. **Preparing to share.** After researching their questions and completing their inquiry charts, children will decide on a product to create as a group. Children will have many options to select from, but products should show what the group has found in their research.
7. **Presenting research.** The culmination of the unit will be a scientific symposium in which the inquiry circle groups will present their final product to the class.

3.4. Selecting Texts for Science Inquiry Circles

Texts used for inquiry circles should be text-rich and varied. "Texts" the children might use for research include trade books, ebooks, websites, and videos. Synthesizing information across multiple types of text is encouraged.

All for Science has provided a list of possible texts to use in inquiry circles. These include trade books that might be found in local and school libraries, ebooks accessible through a free account, and open-access web resources.

The list also includes some web-based text resources that require accounts to access (BrainPop, Brittanica Kids, etc.). Teachers should check with a campus librarian or tech specialist to find out what resources are subscribed to by the school.

3.5. Role of the Teacher in Science Inquiry Circles

Before Inquiry Circles. This is typically a 5-minute introduction where you might outline the goals for the day's inquiry work. You will want to include where in the inquiry process the class is and what the next step in the process will be. This is a good time to remind children of their team roles and the strategies they might use during their inquiry work.

During Inquiry Circles. During this time, scientists will work independently and with their teams. The teacher is primarily a facilitator. You might help your scientists locate a resource, answer questions and clarify directions, suggest a strategy, or simply talk with scientists about their research. You might consider moving about the room and taking a moment or two to check in with each inquiry circle group.

After Inquiry Circles. This is typically a 5-minute closure to wrap up the day's inquiry work. Each group should have the opportunity to discuss their work for the day and share their progress with the class. Though scientists will be leading their own discussion within their groups, you might initially provide possible questions to help guide their discussions.

3.6. Science-based Mini-lessons: Metacognition and Metalanguage toward Strategic Reading (Declarative, Conditional, Procedural)

Research on improving reading comprehension has shown that children (even young children) can learn to be more strategic in their reading through intentional instruction.[9] Examples of intentional instruction include providing opportunities for readers to engage in reading strategies and "think alouds" of teachers' processing the use of metalanguage to support the development metacognition (i.e., naming and describing what they're doing as they read to monitor their comprehension).

The mini-lessons in *ALL for Science* units are written to teach children directly the three ways in which strategic readers learn and apply strategies for reading comprehension. All three are important in the processing of texts.

- **Declarative**. What the reading strategy is and the name for it.
- **Conditional.** When to employ the strategy and why the strategy is important to comprehension.
- **Procedural.** The cognitive processing behind the strategy.

3.7. Texts that Support Learning: Anchor Charts

Teachers use anchor charts during the modeling of strategic reading mini-lessons. For each lesson, we have provided sample anchor charts that visually represent metacognitive learning. We encourage you to recreate these charts *with your learners* to anchor their learning.

The more involved learners are in creating these anchor charts, the greater ownership they will take in using the strategy. We advise you to place anchor charts in a visible location within the classroom so learners can use them often. Each day's anchor chart should remain visible throughout the unit. We encourage you to model the strategy with the anchor chart during the whole-class activity so learners can then apply the same strategy(ies) within their inquiry circle groups.

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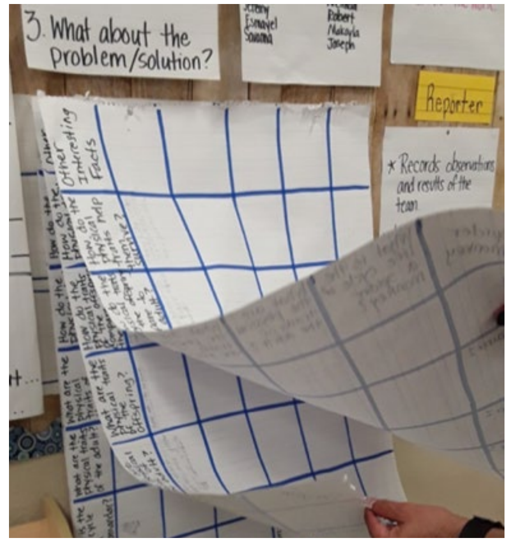
[9] Sailors M, Price L. 2015. Support for Improvement of Practices through Intensive Coaching (SIPIC): A model of coaching for improving reading instruction and reading achievement. *Teaching and Teacher Education* 45: 115-127.

3.8. Texts that Support Learning: Inquiry Charts

Inquiry charts support text-based research and are a way to organize information. Each small group makes its own inquiry chart, organized around the research questions (see suggested questions at the top of the sample chart provided with each unit) and the sources that scientists use in their inquiry. As children find answers to their questions, they populate the inquiry chart. The information on the inquiry chart is summarized, synthesized, and presented in the culminating project.



Example of Inquiry Charts posted to a bulletin board and retrieved when students break into their inquiry circle groups.

3.9. Texts that Support Learning: *Portal Texts*

Portal texts are fictional texts designed to grab learners' attention and engage them in the subject matter. Learners can use the texts to build connections and generate research questions. We have provided sample portal texts, but you may choose others, based on needs and availability. Choose texts that will be engaging and spark the interest of your learners. We recommend that you choose one portal text per group, to be read by learners within the inquiry circle groups. Ideally, portal texts are used before starting the research, but some texts may be difficult for students to read without teacher assistance. Therefore, you may elect to read one portal text aloud each day during class time.

3.10. Selecting Appropriate Informational Texts

We have provided a list of possible expository texts, websites, and online books on each unit's landing page at www.BioEdOnline.org. You may choose to use other books, based on availability. We encourage you to provide each group with numerous and diverse sources. Look for expository texts with a variety of text features (e.g., table of contents, headings and subheadings, diagrams, captions, index, glossary), an appropriate reading level, current and accurate information, and colorful photos or scientific illustrations.

3.11. Assigning Small Groups in Inquiry Circles

You may use a variety of methods to assign groups for the inquiry circles. Naturally occurring groups may already be in place in your classroom (e.g., table groups, reading groups), or groups may be formed based on learner interest in the organisms. You may choose to keep learners in the same groups during both the science investigation activities and the inquiry circles, or may choose to reassign groups. We recommend forming heterogenous groups while providing learners opportunities to choose their topics of interest.

3.12. Products to Celebrate Learning in Inquiry Circles

At the end of an inquiry project, scientists frequently make a product (e.g., scholarly paper or presentation) to share what they have learned. Similarly, you might allow your learners to share their findings by have having each inquiry circle group choose one product to create as a team.

The product should show what learners discovered about their topic. For instance, in the second grade *Heredity and Life Cycles* unit, students could display their organism's physical traits in adults and offspring. On the last day of the project, all groups should present their findings during a scientific symposium.

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