

Reading for claims and evidence: using anticipation guides in science

by Jerine Pegg and Anne Adams

Making predictions and supporting claims with evidence and reasoning are science and engineering practices considered integral to laboratory work, but these skills can also be developed by critically engaging students in reading scientific texts. Anticipation guides are a content literacy strategy that supports students in developing scientific reasoning skills, understanding scientific concepts, engaging in aspects of scientific argumentation, and developing reading-comprehension abilities. In this article, we describe specific considerations for using anticipation guides in science instruction that were developed from four years

of work with teachers in the Literacy Instruction in Mathematics and Science for Secondary Teachers project at the University of Idaho.

Anticipation guides

Anticipation guides were initially developed by Herbert (1978) as a strategy for activating students' prior knowledge of a subject before reading by having students identify whether they agree or disagree with a set of teacher-generated statements related to the reading. Since that time, others have enhanced this strategy to include during-reading and after-



FIGURE 1

Example anticipation guide

Anticipation Guide: Necessities of Life

Name _____

Period _____

Before Reading: Decide whether the statements below are true or false. In the before column place a T (true) or an F (false). You must make a decision. Do not leave any blank.

During or After Reading: Review your responses and place a T (true) or an F (false) in the "After" column for each statement. Underneath each statement, provide evidence from the text that supports your thinking. Reference ideas from the text with the page number where the information was found.

Before AfterT T

1. All living things need water.

*you can't survive without water for 3 days
p. 42*

T F

2. You, a plant, a mushroom, and a bug all have very different needs.

because all need water & food p. 42

T F

3. The European Diving Spider can hold its breath for a long time.

it surrounds itself with a air bubble p.45

reading components that require students to reassess their initial thinking and provide evidence from the text that supports or refutes their initial decision (Dufelmeyer 1994; Kozen, Murray, and Windell 2006).

Although anticipation guides can be used in any subject area, they are particularly useful in reading scientific texts. The prereading components of anticipation guides provide an opportunity to activate and assess students' prior knowledge, reveal their preconceptions, motivate them to engage with the text, and prepare them to read with understanding. During reading, anticipation guides engage students in evaluating claims, comparing their prior understandings with the text, and justifying claims with evidence from the text. After reading, students communicate and justify their answers based on evidence

from the text, which can lead to rich discussions of scientific ideas and relationships between claims and evidence. Anticipation guides provide scaffolding for students to engage with text materials and actively participate in scientific communication and argumentation.

Reading scientific texts can be challenging for students due to the high concentration of complex ideas, technical vocabulary, expository text structures, and various text forms, including tables, graphs, and pictures (Barton and Jordan 2001). When reading such texts, students often struggle to identify key ideas and relate details to larger conceptual structures. Well-designed anticipation guides can support students in seeing how different aspects of textual information relate to larger conceptual ideas.

Designing anticipation guides

To create an anticipation guide, first determine which reading the anticipation guide will be based on and the main concepts you want students to learn from the reading. Readings can be drawn from adopted textbook materials or science articles at a reading level appropriate for your students. If using a textbook reading, limit the selected text to only a few pages so that students have sufficient time to read carefully. It is useful to refer to state and national standards documents and research on common student alternative conceptions to identify key ideas related to the topic.

When designing anticipation guides, it is important to consider both the specific statements that will be employed and the design of the response sheet students will use (see Figure 1). Anticipation-guide statements are particularly useful when they provoke critical thinking by requiring students to interpret and synthesize information from various places in the text. This can happen by doing the following:

1. *Including statements that address key concepts and possible student misconceptions.* When writing anticipation-guide statements, focus on key concepts from the reading rather than specific factual information. Including statements that relate to common student alternative conceptions is useful for eliciting prior conceptions and beliefs. It is also important to word statements in ways that allow students to make predictions prior to reading. For example, statements such as “The graph on page 34 provides evidence for the theory of evolution” do not permit students to reflect on their prior knowledge regarding the topic.
2. *Including statements that require inference from the text.* To encourage interpretation of the text, statements should require inference from and not match the exact wording of the text. The goal is for students to read, think about the ideas, and work to make sense of them, not to simply locate and copy exact phrases from the text. Using statements that require students to pull information from multiple places, including charts, tables, and figures, will encourage them to examine material that is located outside the main body of the text and lead to richer discussions. Students often overlook tables, charts, and figures when reading (Weidenmann 1989), and including statements that require information from these text features emphasizes the relationships between them and the ideas in the text.
3. *Including statements that purposefully generate argument and debate.* In order to encourage discussion, include some statements that do not necessarily have a right or wrong answer. Statements such as “Bacteria are harmful” that may have incomplete or conflicting textual evidence can lead to rich discussions. When writing statements, make certain that students can support or refute the statements using information from the text. It is not necessary that the statements have a clear answer, but rather that the text provides some form of support students can use to engage in argument and debate regarding the statements.
4. *Limiting the number of statements included in any particular lesson.* Responding to anticipation-guide statements and locating evidence in the text requires more time than answering typical worksheet questions. Students need time to carefully read and interpret the text. If too many statements are included or too little time is provided, students will fall back on quick hunt-and-search strategies to find simple answers rather than reading and interpreting, thereby limiting the effectiveness of this approach. Beginning with statements for which evidence is easier to find will make students comfortable with the process. Follow these with more ambiguous or controversial statements that will encourage deeper reading and fruitful discussion.

When designing the anticipation guide, provide space for students to state their agreement or disagreement with the statements prior to and after reading. Some teachers require students to write their predictions in pen so students do not change initial responses. On the handout, make sure there is room for students to provide their reasons for agreeing or disagreeing with the statement, including specific evidence from the text that supports their decision. This forces students to confront their misconceptions and emphasizes the importance of providing support for claims.

Teaching with anticipation guides

When first using anticipation guides with students, it is helpful to model the process of reading for evidence. Many students are used to worksheets that only require searching for answers using keywords

or phrases in the text. Anticipation guides with statements requiring critical thinking and interpretation cannot be answered using this same strategy. A strength of anticipation guides is their ability to engage students in discussion and reasoning when there aren't clear answers. However, students can become frustrated when first responding to these types of statements. A teacher recounts one such example:

I had a statement that says that the European diving spider can hold its breath for a long time, when all the book says is that it goes to great lengths to bring an air bubble with it... That really got students thinking... It really frustrated a number of students and they kept coming up to me and asking, "What is the right answer?" when the text didn't just come out and say.

To forestall such frustration, explain the differences between an anticipation guide and a typical reading guide and model examples for students where evidence supporting or disputing the statement is not directly stated in the text. Choosing a statement, such as the one in the quote above, and discussing this with the whole class prior to students working independently can model this process.

When using anticipation guides, teachers found the following strategies useful during various stages of the lesson. Prior to reading, it is helpful to have students read the statements independently and record whether they agree or disagree with the statements before discussing their predictions with others. One strategy that our teachers found particularly useful was to have groups of two to four students, after making their predictions, discuss statements on which they disagreed, providing justification for their choices. When giving instructions, remind students that, during independent reading, they are to provide evidence from the text that either supports or refutes the statement. You may also want students to list the page and paragraph where the information was found so that they can refer to it easily during the postreading discussion. As this part of the process is completed individually, teachers should plan for students to require different amounts of time. Expect students to take roughly twice as long as the teacher to read and respond to the anticipation guide.

Postreading discussions are a critical component of

using anticipation guides, giving students the opportunity to review their thinking and provide evidence from the text to support their understandings of the reading. You may want to allow students to first discuss their ideas in a small group before discussing with the whole class. Small-group discussions give students the opportunity to first share their thinking in a safer setting, increasing their comfort level when discussing in the larger group. Grouping should be determined based on teachers' knowledge of their students and how they will best work together. At times, consider grouping together students with different reading levels. They will likely notice different things and will be able to share their ideas and help each other interpret the concepts in the reading. However, avoid grouping students with widely different knowledge or skills, as they may have difficulty talking to each other about technical material. During the whole-class discussion, act as a moderator and keep the focus on students supporting their claims with evidence, rather than on whether or not students identified the "right" answer. Some teachers in our project purposefully did not write an answer key prior to the lesson so that they would focus on encouraging students to provide their evidence and reasoning rather than jumping too quickly to the "correct" answers. During the discussion, encourage students to defend their positions. After one student or group provides findings and evidence, ask other students for additional evidence to support or refute the statement. For statements that do not have clear answers, encourage students to clarify their arguments by including qualifiers regarding their decisions to agree or disagree with the statements.

Due to the nature of the statements and the importance of discussion, completion of an anticipation-guide activity takes more time than a typical text-based reading assignment. Make sure to plan enough time for careful reading and interpretation of the text, as well as for prereading and postreading discussion. Unless the reading is quite short, it may take a full 45-minute period to complete the entire process.

Conclusion

Teachers' reflections on the use of anticipation guides in their teaching highlight the value of this strategy for student learning in science. Teachers described how the anticipation guides helped them better understand their students' thinking and allowed them

to identify and target student misconceptions. In reflecting on a lesson, one teacher related:

Their anticipation guide stated three different causes of wind, and by the end of this everyone was able to correctly identify that all three statements were true. That was different from the beginning of the lesson where I saw many students pick out one cause they thought was true and then automatically mark the other two false, assuming that there must be only one right answer.

Teachers also identified ways in which the anticipation guides encouraged the development of critical-thinking and argumentation skills in their students:

The students are better able to come up with points of evidence... Knowing they would have to defend answers to their peers made most of them gather good evidence and keep track of it.

It was great when they referred back to the text to try to prove an answer to another student... They not only debated the answer themselves, but what they put as proof. It really made me smile when I heard a student say, "Yeah, well, my evidence is better!"

Teachers' reflections also described how the use of the anticipation guides resulted in increased student engagement compared to previous lessons:

The students are definitely more engaged in their reading by spending more time on it with an anticipation guide. It takes a whole period instead of 5–8 minutes, but I think it is time well spent.

Last year we just read the chapter and I had

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students answer the questions, which worked, but it didn't make the students think about what they were reading. The anticipation guide really allowed the students to take the information and look at it in different ways and then debate and discuss it.

Students can benefit from opportunities to read critically, interpret what they are reading, and support their claims with evidence. Anticipation guides are well positioned to support all three of these functions. These guides serve as motivators to engage students in actively considering key ideas of the content they are learning while they develop reading-comprehension and science skills that will serve them in many aspects of their lives. ■

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