

A Guide to Developing Literacy Practices in Science

Engaging with Text Through Active Reading: Wind Currents

Strategy Guide

The Learning
Design Group



Earth Science

Grades 6–8

Overview

What's in this guide? This strategy guide introduces Active Reading, an approach to teaching students how to read science text deeply and carefully. During Active Reading, students annotate the text, engage in peer discussion about the text, and return to the text with a specific focus. This guide includes a plan for introducing students to Active Reading with the article *Fremantle Doctor Wind: A Sea Breeze*, which explains the concept of air flow and how sea breezes are formed.

Why Active Reading? Reading and comprehending science texts is different than reading texts in other disciplines such as history or language arts; even students who are strong readers can have difficulty adjusting the way they read in science class. Through engaging in the practice of obtaining, evaluating, and communicating information from text, students can begin to master the ways of thinking and communicating that are specific to the discipline of science and that will enable them to build an understanding of key science ideas.

How This Fits Into Your Science Curriculum

Reading *Fremantle Doctor Wind: A Sea Breeze* provides an opportunity for students to apply their understanding of how temperature and density affect air currents. This strategy guide fits in well toward the end of a unit on density, air currents, or weather; students can use the article as an opportunity to discuss and solidify their thinking about these ideas. It is important for students to understand that in warm air, the molecules are spread farther apart, making it less dense; in cooler air, the molecules are closer together, creating an increase in density. Students should also know that due to the differences in density, when a cool air mass and a warm air mass meet, the warm air rises, and the cool air falls below.

Addressing Standards

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas

ESS2.C: The Roles of Water in Earth's Surface Processes: The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.

Crosscutting Concepts

Cause and Effect: Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Science and Engineering Practices

Asking Questions and Defining Problems: Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.

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COMMON CORE STATE STANDARDS FOR ELA/LITERACY

Reading Standards for Literacy in Science and Technical Subjects 6–12

RST.6–8.1: Cite specific textual evidence to support analysis of science and technical texts.

RST.6–8.10: By the end of grade 8, read and comprehend science/technical texts in the grades 6–8 text complexity band independently and proficiently.

Science Background

Interactions of **air masses** result in changes in weather conditions and can determine **weather patterns**. **Wind currents** are often caused by **temperature** differences in different air masses. When an air mass becomes warmer, it becomes less **dense**. If there is cooler, more dense air nearby, that air will move as a wind current along the surface of the ground or water toward the region of warmer, less dense air. The warmer air will rise. This mechanism causes **sea breezes**—such as the Fremantle Doctor Wind acting on the coast of Australia—because in the daytime, the air mass over the land becomes hotter and less dense than the air over the sea. On a more global scale, warmer, less dense air masses at the equator and cooler, more dense air masses to the north and south give rise to **prevailing winds**, which are long and steady winds that follow predictable patterns of movement.

Getting Ready

1. Read the *Fremantle Doctor Wind* article and prepare to model Active Reading. Make sure you have a way to project the article (and the Example Annotations) during class.
2. Make one copy of the article for each student.
3. On chart paper, record the Active Reading Guidelines and post them where they will be easily visible to all students.
4. On the board, write "Think about a windy place near a body of water. This can be one that you have visited or one that you can imagine. Sketch a picture of this place."

Activating Background Knowledge (5 minutes)

1. **Students sketch.** Ask students to quickly sketch a picture of this windy place (such as a beach, near a lake, etc.). Have them include the following in their drawings: a piece of land, a body of water, wind blowing, arrows showing the direction the wind is blowing.
2. **Pairs discuss.** Have students discuss their drawings with partners. Circulate while pairs are sharing in order to gather students' background knowledge and/or misconceptions about wind and the direction in which it moves.

Introducing Active Reading (5 minutes)

1. **Introduce reading.** Connect today's activity to the practices of scientists. Say, "**Scientists read a lot. They read investigations that other scientists have done, and they read to learn more about topics they are investigating themselves. Scientists read carefully and critically, making sure they understand the**

ideas in the text. It's important that when learning to read like a scientist, you read thoughtfully and carefully, keeping track of your own thinking as you go."

2. **Project Example Annotations.** Project the Example Annotations and explain that this is an article that another middle school student annotated as she was reading deeply and carefully.
3. **Pairs discuss example annotations.** Have pairs briefly discuss what they notice. Then, have a few students share their responses with the class. If it doesn't come up in the discussion, point out that the example has annotations for the photographs as well as for the text.
4. **Introduce Active Reading Guidelines.** Explain that students will learn how to read carefully and thoughtfully, just as this other student did. Explain that older, sophisticated readers often

Supporting English Language Learners

Extending your modeling of Active Reading with a small group of ELLs will help them surface their questions and confusions about the text in a supportive environment. Before students read, choose a section of *Fremantle Doctor Wind* to read with a small group of ELLs. Read this part of the text aloud and think aloud as you read. Stop to show students what to do when you don't understand part of what you've read. You could choose to focus on one of the following strategies: rereading the confusing part of the text, checking the visual representations, making a note of what you did not understand, or circling unknown words as you continue to read. Encourage students to use this practice when they read.

Importance of Teacher Modeling

Active Reading is based on a growing understanding of how older students can be taught to read effectively in the content areas. As content experts, science teachers already understand how to read science texts effectively. During Active Reading, teachers use their content-area expertise to make their thinking processes explicit for students. This is accomplished through modeling—the teacher states her thought processes aloud as she reads a selection of text for students. This apprentices students to read thoughtfully and in a sophisticated manner, which helps them understand science texts. If think-aloud modeling is already familiar to you, then we encourage you to provide modeling that reflects your own questions and ideas that you think about as you read the article. If you are less familiar with this method of teaching, this strategy guide provides questions and comments you can use to think aloud. The goal of teacher modeling is to enable all students to engage in deep and curious reading, using similar strategies and attitudes you might expect when your students engage in inquiry. The more you model this yourself, the more successful it will be.

use these strategies. High school and college students often keep track of their thinking by writing directly on their texts.

Modeling Active Reading (5 minutes)

1. **Project article.** Explain that students will read an article about air currents (wind). Remind them that in denser air, the molecules are closer together; in less dense air, the molecules are spread farther apart. Explain that today, students will be reading about how density impacts wind.
2. **Model making connections.** Begin by reading the title of the article aloud. Continue reading the first few sentences of the article aloud. Say, **"I don't think I know what 115 degrees feels like, but I have been somewhere where the temperature was a little over 100 degrees."** Circle the temperature and then draw an arrow from the temperature to the margin and write "This heat reminds me of a place that I visited."
3. **Model asking questions.** Continue reading aloud until you have read through the second paragraph. Say, **"This paragraph is about the wind blowing in from the ocean and decreasing the temperature by several**

degrees. I wonder if the wind only blows on hot summer days." Next to the second paragraph, write "Does the Fremantle Doctor Wind only blow in the summer or in winter, too?"

4. **Make a connection to the images.** Point out that both images on the first page show the same thing—where the Fremantle Doctor Wind blows. The image on the top is a photograph of the Perth coast; the image on the bottom is a map that shows the direction of the wind as it blows toward the Perth coast. Draw a line connecting the two images. On the line, write "The wind in the photograph is blowing toward the beach."

Reading the Article (15 minutes)

1. **Students read.** Distribute copies of the article and have students begin reading and annotating the article individually. Let them know that they will each have a chance to talk to a partner about questions and connections they are still wondering about when they are finished reading.
2. **Find exemplary annotations.** While students are reading, circulate and look for a few annotations that you think are particularly insightful or interesting. Try to find students' questions or connections that link what students have been learning in science class to ideas in the article. Make note of these to bring up later in the session.

Discussing the Article (10 minutes)

1. **Set purpose.** Point out that an important way for people to gain a deeper understanding of something they are reading is to discuss it with others.
2. **Project Example Annotations again.** Point out that this student made a number of annotations and placed a star next to the annotation she wanted to discuss with a partner.
3. **Explain procedure for discussing annotations.** Explain the following procedure that students will use to discuss their annotations with partners.
 - **Partner #1 chooses an annotation to share.** Partner #1 makes a star next to the annotation she chooses to share first. If it is a comment or a connection, she should explain why it was important to record. If it is a question, she should explain why she asked it.

- **Partner #2 responds.** If it is a question, both partners work together to try to figure out an answer. This might mean rereading part of the text.
 - **Mark the annotation.** Partner #1 places a check mark near the annotation if she feels that discussing this annotation has helped her better understand it. She should circle the annotation if she would like to discuss it further with the rest of the class.
 - **Switch roles.** Partners then switch roles and follow the same procedure. Students should continue discussing annotations until time is up.
4. **Pairs discuss annotations.** Allow a few minutes for pairs to discuss their annotations. Be sure to encourage students to return to the text to clarify their understanding and to try to answer questions. Make note of any interesting discussions you hear.
 5. **Discuss annotations as a class.** Have a few students discuss their annotations with the class. Allow other students to respond to questions, ideas, and connections.
 6. **Highlight interesting annotations.** If you noticed any particularly interesting or insightful annotations or discussions as you circulated throughout the room, bring these up now (with students' permission). Use this opportunity to point out instances of thoughtful, careful reading.

Reflecting on Active Reading (5 minutes)

1. **Reflect on the process.** Ask students to reflect on the practice of Active Reading. Ask questions such as:
 - "What questions do you still have after reading?"
 - "What connections did you make?"
 - "Does anyone have an example of how they annotated the visual representations? How did this help you understand the article?"

Connecting to Standards

Active Reading is an approach that capitalizes on the overlap between the science practices in the Next Generation Science Standards (NGSS) and the Common Core State Standards (CCSS) for English Language Arts. One way that Active Reading meets these standards is through the discussion of annotations. Discussing annotations gives students the opportunity to ask and answer questions by using evidence in the text (NGSS Science Practice 1: Asking Questions and Defining Problems) and is likely to provide authentic reasons for students to cite specific evidence to support analysis of the text (CCSS.ELA–Literacy.RST6–8.1). In addition, Active Reading capitalizes on peer interactions in order to allow students to build on one another's ideas and express their own ideas more clearly (CCSS Anchor Standard 1 for Speaking and Listening).

2. **Conclude.** Summarize the discussion by highlighting students' ideas about how Active Reading was helpful for their understanding.
3. **Follow up.** In another session, plan to reread the article or a portion of the article for a specific purpose. Select this purpose based on the needs of your class. Have students focus on this purpose as they reread and discuss further. For instance, you could have students focus on understanding the visual representations of wind in the article, or reread to understand how density relates to wind, or reread to ask questions that would lead to designing firsthand investigations of wind.
4. **Make Active Reading part of your classroom routine.** Keep the Active Reading Guidelines posted and refer to them as students are reading other texts. Encourage students to make annotations and discuss their ideas about the texts.

Generalizing This Practice

Active Reading is an approach that can be used throughout your science curriculum with a variety of texts and topics. A benefit of having students engage in Active Reading is that this approach makes reading a student-centered rather than a teacher-driven experience, allowing students' genuine understandings, misunderstandings, and questions about the text to emerge and prompt further discussion of science ideas. It also helps students learn general strategies for accessing and engaging with complex texts. Use the following steps to teach Active Reading with other science texts.

1. **Select a text.** The text should be related to a science topic under study and at a level that students can access more or less independently. Try to find a text that includes visual representations (images, diagrams, tables) that support or extend the words. These texts can include articles, procedures, descriptive or explanatory information, lab procedures, or any other text that is part of your science program.
2. **Introduce Active Reading.** Use the Active Reading Guidelines to introduce the process of Active Reading. Focus on the idea of slowing down and reading carefully, taking time to make your thinking visible through annotations.
3. **Model thinking aloud.** Model the process of reading actively and focusing on cognitive strategies that students might use as they read. Make sure to include this step each time, even if it is brief, as it is especially helpful for students who struggle with reading. You can highlight a different type of annotation each time students read. For example, in one session, you can focus on asking thoughtful questions; in another session, you can focus on making connections between the text and science investigations done in class. Alternatively, using your students' annotated texts as models is a very effective method for teaching students to think about and interact with text.
4. **Students read and annotate.** Encouraging students to annotate the text by taking notes and recording questions allows authentic student questions to surface. It also offers a window for formatively assessing students' thinking around concepts presented in the article.
5. **Pairs discuss annotations.** Providing students the opportunity to discuss their annotations enables discussion points to emerge from students rather than from the teacher.
6. **Debrief discussions.** After pairs discuss, have the whole class discuss annotations. This is a good time to highlight and reinforce strategies that you saw students using as they read. For example, if you were focusing your modeling on asking questions related to the text, point out how students did this as they were reading.
7. **Reread for a specific purpose.** Have students reread the text or a portion of the text for a specific purpose. This encourages revisiting the text to find out more about particular topics (after students have gained an initial understanding of the text during the first read). Rereading the text also provides an opportunity to focus the discussion of the text on particular concepts in order to connect to subsequent science activities.

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. Ask questions, make connections, and make comments as you read. Write these down to keep a record of your thinking.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. Discuss what you read with others to help you understand the text.

Example Annotations

→ That's an odd name for wind.

FREMANTLE DOCTOR WIND: A SEA BREEZE

Imagine yourself on a hot summer day, lying on the beach in Perth, Australia. It's the middle of January. (Because Australia is in the southern hemisphere, it's summertime there from December through March.) The temperature is a sweltering 115°F. Suddenly, a cool breeze begins blowing, bringing relief from the summer heat. The Fremantle Doctor has just arrived!

This is winter in other places.

What does this mean?

The Fremantle Doctor is the name the people of Perth have given to the wind that regularly blows in from the ocean on hot summer afternoons. People probably named this wind "doctor" because of the way it makes people feel better on dangerously hot days. When the Fremantle Doctor wind blows, the temperature often drops by several degrees.



Perth is a city on the western coast of Australia. Perth is known for its beaches.

What makes heat so dangerous?

Does the wind only cool people on the coast, or also people in the city?

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Wikimedia/Orderinchaos

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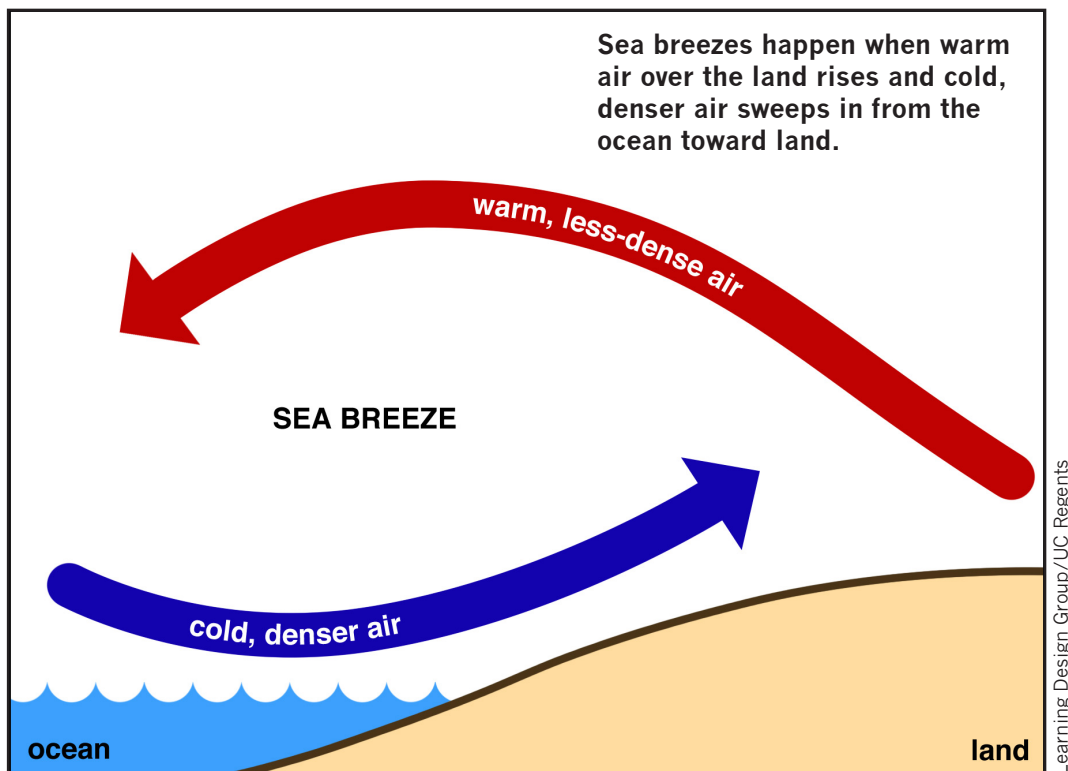
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Like all winds, the Fremantle Doctor is a current of air. Wind happens when air masses with different densities are near each other. The less-dense air rises and the denser air flows along the ground, pushing in under the less-dense air. In general, warmer air is less dense and colder air is denser.



Wikimedia/TUBS

The Fremantle Doctor is an example of a type of wind called a sea breeze. Sea breezes happen in areas along the ocean shoreline. On hot, sunny days, the land warms up faster than the water. The warm land heats the air above it, making the air above the land warmer than the air above the water. Because the air above the land is warmer, it is also less dense than the air above the water. The warm, less-dense air above the land rises, and the colder, denser air above the water flows in a current toward the land—a sea breeze. The greater the temperature difference between the water and the land, the stronger the sea breeze blows.



December and January are the months when the Fremantle Doctor blows strongest, because the land is hot and the water is cold. The land is still hot in February and March, but the water is warmer then, so the Fremantle Doctor does not blow as strongly. That's because there is not as big a difference in temperature between the water and the land.

About Disciplinary Literacy

Literacy is an integral part of science. Practicing scientists read, write, and talk, using specialized language as they conduct research, explain findings, connect to the work of other scientists, and communicate ideas to a variety of audiences. Thus, the Next Generation Science Standards (NGSS) and the Common Core State Standards (CCSS) alike call for engaging students in these authentic practices of science. Through analyzing data, evaluating evidence, making arguments, constructing explanations, and similar work, students engage in the same communicative practices that scientists employ in their profession. Through supporting and engaging students in science-focused literacy and inquiry activities that parallel those of scientists, students master discipline-specific ways of thinking and communicating—the disciplinary literacy of science. Strategy guides are intended to help teachers integrate these disciplinary literacy strategies into the science classroom.

About Us

The Learning Design Group, led by Jacqueline Barber, is a curriculum design and research project at the Lawrence Hall of Science at the University of California, Berkeley. Our mission is to create high-quality, next-generation science curriculum with explicit emphasis on disciplinary literacy and to bring these programs to schools nationwide. Our collaborative team includes researchers, curriculum designers, and former teachers as well as science, literacy, and assessment experts.



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