FIGURE 6 DNA models

and sets the DNA code. The strips are color-coded so that red is adenine, blue is thymine, green is guanine, and yellow is cytosine (These are the colors in our textbook. Other colors could be used). The phosphate pieces were brown paper (other colors could be used). I also have students write A, T, C, and G on the corresponding strips and P on the small brown pieces to better help them understand the model they are creating.

The next step is for groups to exchange the halves of DNA they have created. They then match the bases with the correct corresponding base (adenine to thymine, guanine to cytosine) and staple them together. Students finalize their model by stapling a second streamer and the phosphate pieces onto the strips to make a complete helix structure. It fits together better if the base pairs are stapled and then the sugar/phosphate section attached. I found that staples work better than any other form of attachment.

I have six groups in each class resulting in six pieces of DNA, which I then staple together to form one very long section of DNA (a chromosome). I hang these from the ceiling of the room, twisting them as I hang so that they look like double helixes. They make very handy models for understanding DNA, chromosomes, and genes. I refer to them often as we study heredity. We usually end up in this unit around the winter holidays each year and the DNA models make very festive decorations!

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Give students a purpose to read

Giving students reading assignments for homework and asking them to answer the questions at the end of the chapter rarely works for my urban science students. However, by implementing techniques learned from reading teachers and science inquiry, I have been able to increase students' retention of the assigned class readings. The quality of the answers to questions on the reading assignments also greatly improved. After some reflection, I found that I gave my students a purpose to read and that has lead to a deeper understanding of the text.

In this article, I outline the questions teachers should ask themselves prior to assigning a reading to ensure purposefulness. By engaging in this process, teachers will be better able to identify a purpose for student reading, thus raising student comprehension. Through an example, I illustrate what actions students do before, during, and after reading within a science lesson cycle structure. Through this process, students gain a purpose to reading.

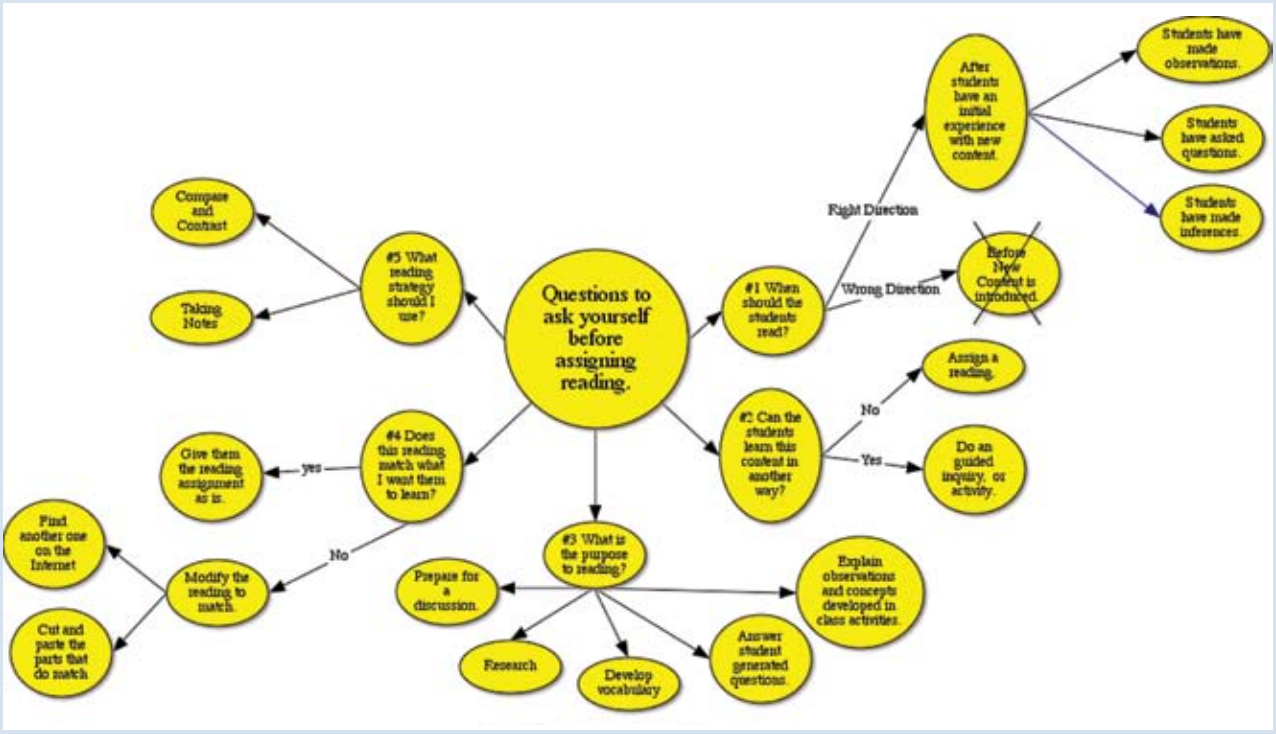
Questions teachers should ask themselves

By asking yourself these questions before you assign a reading, you are being intentional about what you are asking students to do (see Figure 1).

Question #1: Can the students learn the content in another way?

If students can learn this information in another way, especially through hands-on or experiential activity, then students should be engaged in that learning experience rather than reading about it. Research tells us that learning science through hands-on experiences provides a much deeper understanding of science content. Throughout this article, I define *inquiry* primarily as the implementation of the 5Es (Engage, Explore, Explain, Elaborate, and Evaluate) learning cycle. In short, students are given an experience with which to make observations and ask questions from,

FIGURE 1 Questions to ask youself



then they research (read or through media such as videos on online material) to confirm what they observed or inferred (Llewellyn 2002).

Question #2: When in the lesson cycle do I assign a reading assignment?

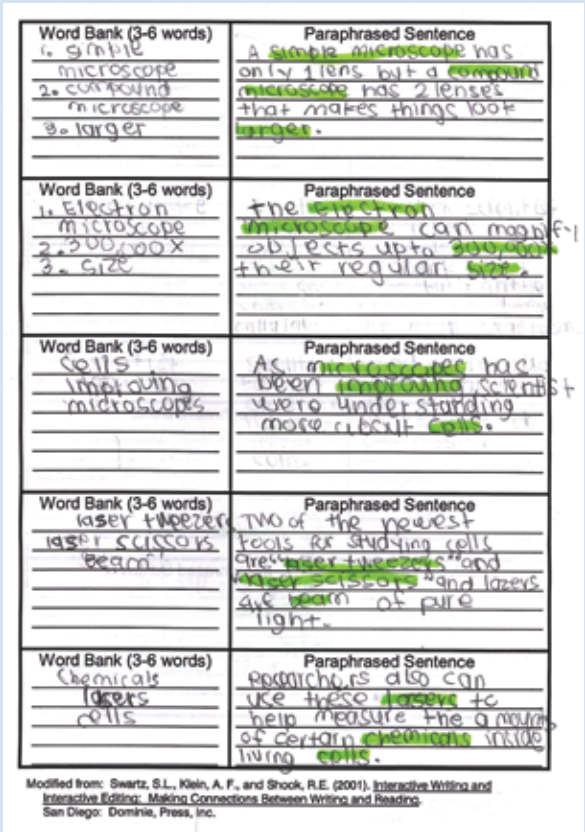
Reading should be assigned primarily after students have had experience with the content. In the inquiry lesson cycle, students Engage and Explore the content first. Through these two stages, students will make observations and inferences and ask questions. These two stages leave the student needing more information, such as new vocabulary, to explain the observations that they made. Concept development is needed to explain the inferences that were made and student questions need to be answered. This is done in the Explain stage of the lesson cycle. For example, a teacher could give students an earthworm to observe and an experiment to design. After students draw conclusions both from their initial observations and their experiment, they can be assigned a reading on earthworms (Llewellyn 2002).

Question #3: What is the purpose of reading for the students?

- Satisfy curiosity
  One purpose of reading is to satisfy curiosity. If students have already experienced the content through an exploration, made observations and inferences, and asked questions, they are ready to feed their curiosity. Often times, students use their own language to explain what they have experienced. Their purpose in reading is to learn vocabulary that will help them better understand and communicate the subject matter clearly to others.

- Answer questions
  Another purpose for reading is to answer the questions students generated during the Engage and Explore activities. Instead of generating questions for students to answer after a reading, students could select the questions they want answered instead. A useful strategy is a modified SQ3R (survey, question, read, recite, review) instead of survey the text and write questions, students are generating their questions from the engage and explore activities.

FIGURE 2 Interactive edit



Word Bank (3-6 words)	Paraphrased Sentence
1. simple microscope 2. compound microscope 3. larger	A simple microscope has only 1 lens but a compound microscope has 2 lenses that makes things look larger.
Word Bank (3-6 words)	Paraphrased Sentence
1. Electron microscope 2. 300,000X 3. size	The electron microscope can magnify objects upto 300,000X their regular size.
Word Bank (3-6 words)	Paraphrased Sentence
cells improving microscopes	As microscopes has been improving scientist were understanding more about cells.
Word Bank (3-6 words)	Paraphrased Sentence
laser tweezers laser scissors beam	Two of the newest tools for studying cells are "laser tweezers" and "laser scissors" and lazers are beam of pure light.
Word Bank (3-6 words)	Paraphrased Sentence
Chemicals lazers cells	Researchers also can use these lazers to help measure the amount of certain chemicals inside living cells.

Modified from: Swartz, S.L., Klein, A. F., and Shook, R.E. (2001). Interactive Writing and Interactive Editing: Making Connections Between Writing and Reading. San Diego: Dominie, Press, Inc.

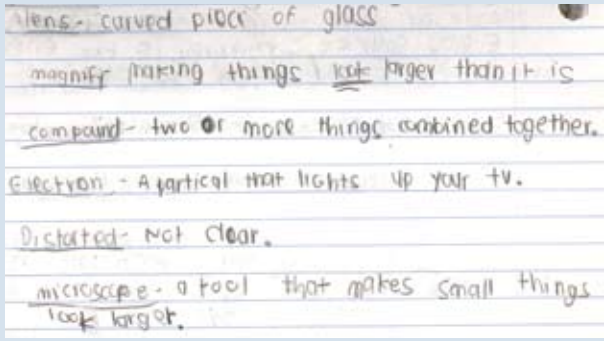
Teachers may already have a clear idea of what they want students to learn and understand from a given assignment. In this case, students read a few paragraphs in class or as homework to prepare for a discussion on the material during the next class period. During the discussion, you can guide and push students to the level of understanding that you wish for them to have.

- Expand learning
  Sometimes the purpose of a reading does not fit with the Explain stage of the inquiry lesson cycle. In some cases, students wish to do more research, or you, as a teacher, assign a research paper or project during the Elaborate or Evaluation stage of the inquiry lesson cycle. In this situation, the purpose for the students is to do research.

Question #4: Does this reading align with what I want the students to learn?

Often times the textbook for the course you are teaching does not match what you want students to learn. The text

FIGURE 3 Dictionary



lens - curved piece of glass
magnify - making things look larger than it is
compound - two or more things combined together.
Electron - A partical that lights up your tv.
Dictated - not clear.
microscope - a tool that makes small things look larger.

either goes too in-depth or does not provide enough detail. Sometimes, the reading does not answer or explain the questions and observations that students made in the earlier stages of the lesson cycle. You often find pieces of what you want from multiple books or on the internet. In order to maintain the purpose you set for your students, you must ensure that the reading you assign them aligns with your objectives and the questions and observations that students In order to do this, you may need to rewrite a reading from multiple sources, giving credit to the sources you used.

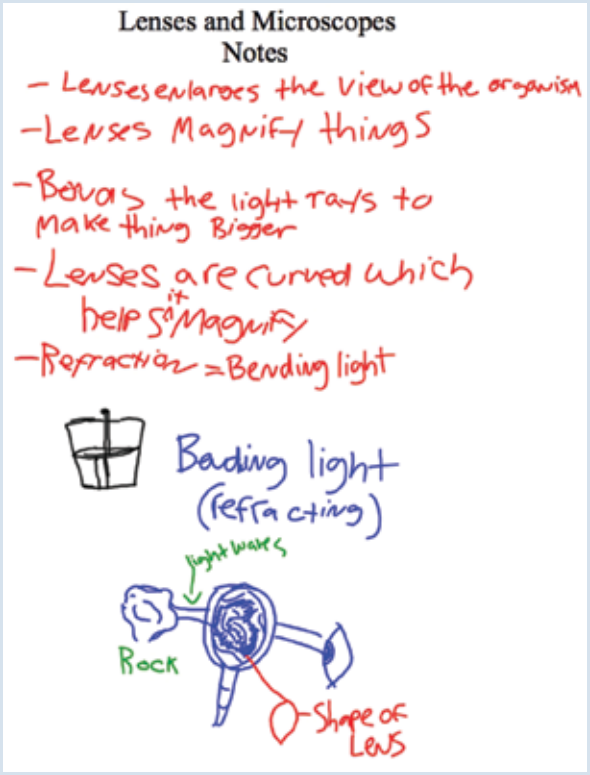
Question #5: What reading strategy should I use?

Students need a strategy with which to attack information. For science reading, I find two main categories of strategies to be useful: comparing and contrasting and taking notes via interactive editing. At the start of the year, I teach students one or two strategies that they will use throughout the year, rather than try a new strategy every lesson. In some cases, students fill out Venn diagrams that compare two or three different concepts or vocabulary words. In most cases, I have students take notes using Adria Kleine's Interactive Editing strategy (Swartz, Klein, and Shook 2001). In this strategy, students identify key words and write a sentence for every paragraph in the reading. See the Resources list for websites where you will find many useful graphic organizers (also see "Using graphic organizers as formative assessment," by Janet Struble).

Conclusion

As adults, we usually read for a purpose, either as entertainment or to learn something new. How can we expect our students to read without a purpose? I have found that by going through this process outlined above, students are more engaged in the

FIGURE 4 Microscope notes



text and getting students to read science text is less of a chore. Every time I plan a lesson using the 5 Es inquiry model, I think about when and if a reading assignment is needed.

Example: How does a microscope work?

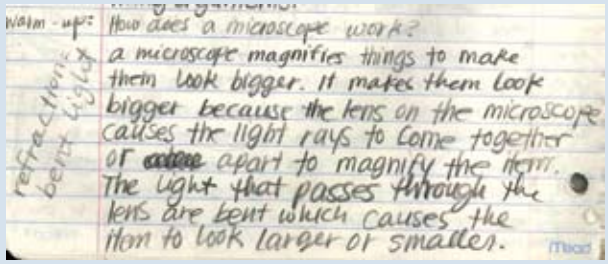
In the example outlined below, students will be learning about microscopes, what they are and how to use them as part of a larger unit on cells in a seventh-grade life science class. Ultimately, students will be using their experiences and the reading assignment on microscopes to answer the question: How does a microscope work?

Engage: The Hand Lens Experience

Student directions:

1. Materials manager gets two hand lenses.
2. Look through one hand lens and make observations.
3. Stack two hand lenses together and make observations about what happens.
4. Try to focus so you can see the image clearly. What did you need to do to focus it?

FIGURE 5 Journal entry



Student responses:

- We couldn't get it into focus, it's just blurry.
- The lenses needed to be only about 15 cm apart; further away, it got out of focus. Closer it was out of focus too.
- The lenses are curved.

The last student statement "the lenses are curved" sets the stage for learning vocabulary words such as convex, concave, and refraction that they will encounter and learn in their assigned reading.

Explore: Learning how to use a microscope

Students learn the parts of a microscope and how to use a microscope.

During this segment, students learn that the stage of a microscope moves up and down, which helps them to understand the statement "The lenses needed to be only about 15 cm apart; further away, it got out of focus. Closer it was out of focus too.

Explain: The microscope reading

Student Directions: Do an interactive editing on the microscope reading; be prepared for a discussion in class.

Student responses:

Explain: Vocabulary

Directions:

1. What vocabulary words, from The Microscope Reading, do we need to add to our dictionary?
2. Define these words, in your own words, and write them in your dictionary.

Student responses:

Elaborate: Discussion and writing notes

Student directions:

How do lenses help us magnify?

- Use The Microscope Reading as evidence.
- Draw pictures if needed.

Student responses:

Evaluate: science journal entry

Directions: Write a journal entry that answers this question: How does a microscope work?

Student responses:

References

Llewellyn, D. 2002. *Inquire within, implementing inquiry-based science standards.* Thousand Oaks, CA: Corwin Press Inc.

Struble, J. Using graphic organizers as formative assessment. *Science Scope* 30 (5): 69–71.

Swartz, S.L., A.F. Klein, and R.E. Shook. 2001. *Interactive writing and interactive editing: Making connections between writing and reading*. San Diego: Dominie, Press, Inc.

Unrau, N. 2004. *Content area reading and writing: Fostering literacies in middle and high school cultures*. Upper Saddle River, NJ: Pearson Education.

Resources

Author's Website—*www.stephsnature.com*

Houghton Mifflin, graphic organizers—*www.eduplace.com/graphicorganizer*

Technology Publishing Company, teacher workbooks, graphic organizer series, science organizers volume 1—*www.teachnology.com/gold/sciorg.html*

Tools for writing and reading, Greece central school district—*www.greece.k12.ny.us/instruction/ela/6-12/Tools/Index.htm*

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Using direct instruction to teach content vocabulary

Do you ever find yourself lying awake in the early morning hours of the day wondering, "How can I effectively teach my students the curriculum so that they are able to succeed and gain confidence in their skills?" We have all been there a night or two, pondering how to best improve our teaching skills so that students in our classrooms learn the material and learn it well.

The magnitude of vocabulary students need to know in the middle school science curriculum is vast and can be daunting. Many of the words related to the science curriculum are extremely specialized and many students enter the classroom with only a very loose understanding of a majority of the words. As educators, it is our job to efficiently and effectively teach students so that they are not only able to apply the new vocabulary to that year's curriculum, but to store it in their memory for future use in high school and college. Often times we have our students look up vocabulary words for a unit of study in the glossary of their textbook and record the definitions in their notes, either as a class warm up or homework assignment. Or we may provide definitions to students to study for the next assessment. Regardless of the method we choose, the underlying question remains: Is this the most effective way for students to learn the specialized vocabulary for a particular unit of study and beyond?

Problems with traditional methods of vocabulary instruction

One traditional method of vocabulary instruction is to have students copy definitions from the glossary or pages of their textbook. This technique, however, has three problems. First, in many textbooks the definitions located in the glossary do not always have a direct link to the topic being taught—they are either too broad or too narrow. Second, many students who copy definitions from their textbook's glossary do so absentmindedly, merely copying symbols on a page, rather than reading the definition for understanding and committing it to memory. These students do not benefit academically from the exercise besides receiving a good grade on a homework assignment. Third, if students navigate through the text to find the definitions of assigned words, their context clues may not be sharp enough to elicit comprehensive definitions, resulting in incomplete or incorrect definitions.