# A Short Guide to Writing about Biology

FIFTH EDITION

JAN A. PECHENIK
*Tufts University*

PEARSON
Longman

New York Boston San Francisco
London Toronto Sydney Tokyo Singapore Madrid
Mexico City Munich Paris Cape Town Hong Kong Montreal

# 6

# WRITING SUMMARIES AND CRITIQUES

For assignments in writing summaries and critiques, you are asked to read a paper from the original scientific literature (the "primary literature") and summarize or assess that paper, usually in fewer than 2 double-spaced, typewritten pages. *Brief* does not, in this case, mean *easy*. In fact, producing that 1- or 2-page summary or critique will probably require as much mental effort as that involved in preparing a full essay or term paper.

On the other hand, once you can write good summaries of individual papers you will have a much easier time writing introductions, discussions, and term papers incorporating multiple references. Indeed, **until you can write clear and convincing summaries of individual papers in your own words, synthesizing material effectively from different sources is virtually impossible**. To do well in these short assignments, you must fully understand what you have read, which usually means that you must read the paper many times, slowly and thoughtfully.

Follow the same procedures whether you are asked to write a summary or a critique; indeed, a critique begins as a summary, to which you then add your own evaluation of the paper.

To begin, read the paper once or twice without taking notes, following the advice given in Chapter 2. Fight the temptation to underline, highlight, or otherwise create the illusion that you are accomplishing something. It is often difficult to distinguish the important from the not-so-important points during the first reading of a scientific paper; skim the paper once for general orientation and overview. Don't try for detailed understanding in the first reading, but do jot down any unfamiliar terms or the names of unfamiliar techniques so that you can look these up in a textbook before you reread the paper.

After you have read the entire paper once, try writing down what you remember about the paper, what you don't understand about what you read, and any other questions that come to mind as you write. This will help to focus your attention on some of the major points for a second reading. It often helps to consult a textbook about the general biology of the organisms being studied or the specific topic being investigated before returning to the paper.





During the next, more careful, reading of the paper, pay special attention to the Materials and Methods and the Results sections; the essence of any scientific paper is contained here, as discussed in Chapter 8. The results obtained in a study depend on how the study was conducted. Were samples taken only at one particular time of year? Was the study replicated? How many individuals were examined? What techniques were used? In an experiment, what variables (for example, photoperiod, temperature, salinity, or food supply) were held constant? Were proper controls provided for each experiment? Which factors might affect the outcome of the study?

As you begin to study the Results section, scrutinize every graph, table, and illustration, developing your own interpretations of the data before rereading the author's verbal presentation, as discussed in Chapter 2. We are readily influenced by the opinions of others, especially when those opinions are well written. Keep an open mind when reading the author's words, but try to form your own opinions about the data first; you may see something that the author did not.

## WRITING THE FIRST DRAFT

You will know that you are ready to write your first draft of the assignment when you can distill the essence of the paper into a single, intoxicating summary sentence, or, at most, 2 summary sentences, as discussed in Chapter 2 (pp. 28–29). These sentences should include *all* the key points, present an *accurate* summary of the study, be *fully comprehensible* to someone who has never read the original paper, and be in *your own words*. As a general rule, **do not begin to write your review until you can write such an abbreviated summary**; this exercise will help you discriminate between the essential points of the paper and the extra, complementary details. Several examples of good summary sentences are given later.

If you cannot write a satisfactory 1- or 2-sentence summary, reread the article; you'll get it eventually. Once your summary sentence is committed to paper, ask yourself these questions:

1. Why was the study undertaken? To answer this, draw especially from information given in the Introduction and Discussion sections of the paper.
2. What specific questions were addressed? Summarize each question in a single sentence.
3. How were these questions addressed? What specific approaches were taken to address each question on your list?
4. What assumptions were made by the author(s)? Might any of them be wrong? Are they testable? How might they be tested?

5. What were the major findings of the study?
6. What was particularly interesting about the paper? The questions asked? Some aspect of the methodology? Some particular result or set of results? Some particular conclusion?
7. What questions remain unanswered by the study? These may be questions addressed by the study but not answered conclusively, or they may be new questions arising from the findings of the study under consideration.

## WRITING THE SUMMARY

When you can answer these questions without referring to the paper you have read, you can begin to write. Writing without looking at the original paper will help you avoid unintentional plagiarism (p. 30), and will self-test your understanding of the paper. You can (and should) always go back to the original paper later to double-check and fill in specific factual details.

At the top of the page—below your name, the course designation, and the date—give the complete citation for the paper being discussed, beginning at the left-hand margin: names of all authors, year of publication, title of the paper, title of the journal in which the paper was published, and volume and page numbers of the article. On a new line, indent 5 spaces and begin your summary with a few sentences of background information. Your introductory sentences must lead up to a statement of the specific questions the researchers set out to address. Next, tell (1) what approaches were used to investigate each question and (2) what major results were obtained. Be sure to state, as succinctly as possible, exactly what was learned from the study.

To cover so much ground within the limits of one typewritten page is no small feat, but it can be done if you first make certain that you fully understand what you have read. Consider the following example of a brief, successful summary. Before writing the summary, the student condensed the paper into these 2 sentences.

> The tolerance of a Norwegian beetle (*Phyllodecta laticollis*) to freezing temperatures varied seasonally, in association with changes in the blood concentration of glycerol, amino acids, and total dissolved solute. However, the concentration of nucleating agents in the blood did not vary seasonally.

Note that the 2-sentence distillation contains considerable detail despite its brevity, implying impressive mastery of the paper's contents; it is complete, accurate, and self-sufficient. When you can write such sentences, pat yourself on the back and proceed; the hardest work is over.



## SAMPLE STUDENT SUMMARY

Minnie Leggs
Bio 101
September 30, 2002

Van der Laak, S. 1982. Physiological adaptations to low temperature in freezing-tolerant *Phyllodecta laticollis* beetles. *Comp. Biochem. Physiol.* 73A: 613–620.

Adult beetles (*Phyllodecta laticollis*), found in Norway, are exposed to sub-zero (°C) temperatures in the field throughout the year. In general, organisms that tolerate freezing conditions either produce extracellular nucleating agents that trigger ice formation outside the cells rather than within them or they produce biological antifreezes, such as glycerol, that lower the freezing point of the blood and tissues to below that of the environment, thereby preventing ice formation. This study (Van der Laak, 1982) documents the tolerance of *P. laticollis* to below-freezing temperatures and determines how seasonal shifts in the temperature tolerance of these beetles are mediated.

Beetles were collected throughout the year and frozen to temperatures as low as −50°C; post-thaw survivorship was then determined. Determinations were also made of the concentrations of solutes in the blood (that is, blood osmotic concentration), total water content, amino acid and glycerol concentrations in the blood, presence of nucleating agents in the blood, and the temperature to which blood could be super-cooled before it would freeze.

The temperature tolerance of *P. laticollis* varied from about −9°C in summer to about −42°C in winter; this shift in freezing tolerance was paralleled by a dramatic winter increase in glycerol con-

centration and in total blood osmotic concentration. Amino acid concentration also increased in winter, but the contribution to blood osmolarity was small compared to that of glycerol. Nucleating agents were present in the blood year-round, ensuring that ice formation will occur extracellularly rather than intracellularly, even in summer.

For beetles collected in midwinter and early spring, blood glycerol concentrations could be artificially reduced by warming beetles to 23°C (room temperature) for about 24–150 h. When glycerol concentrations of spring and winter beetles were reduced to identical levels by warming, the spring beetles tolerated freezing better than the winter beetles; these differences in tolerance could not be explained by differences in amino acid concentrations. This result indicates that some other factors, as yet unknown, are also involved in determining the freezing tolerance of these beetles.

### Analysis of Student Summary

The student has, within one typed page, successfully distilled a 7-page technical report to its scientific essence. Note that the student used the first 3 sentences to introduce the topic and then summarized the purpose of the research in one sentence. The next short paragraph summarizes the experimental approach taken, and the main findings of the study are then stated. No superfluous information is given; the author of this assignment provided only enough detail to make the summary comprehensible. The product glistens with understanding. Rereading the student's 2-sentence encapsulation of the paper (p. 124), you can see that the student was indeed ready to write the report.

As a challenge to yourself, try writing a one-paragraph summary of the above example, cutting the length of the original summary by about 75%. Summary is the ultimate test of understanding.

## WRITING THE CRITIQUE

A critique is much like a summary, except that you get to add your own assessment of the paper you have read. This does not mean you should set out to tear the paper to shreds; a critical review is a thoughtful



summary and analysis, not an exercise in character assassination. Most biological studies have shortcomings, most of which become obvious only in hindsight. Yet every piece of research contributes some information, even when the original goals of the study are not attained. Emphasize the positive—**focus on what was learned from the study**. Although you should not dwell on the limitations of the study, you should point out these limitations toward the end of your critique. Were the conclusions reached by the authors out of line with the data presented? Do the authors generalize far beyond the populations or species studied? Which questions remain unanswered? How might these questions be addressed? How might the study be improved or expanded in the future? Keep this in mind as you write: you wish to demonstrate to your instructor (and to yourself) that you understand what you have read. Do not comment on whether or not you enjoyed the paper, or found it to be well written; stick to the science unless told to do otherwise.

### The Critique

Before writing the critique, the student produced this one-sentence summary of the paper.

> The egg capsules of the marine snails *Nucella lamellosa* and *N. lima* protect developing embryos against low-salinity stress, even though the solute concentration within the capsules falls to near that of the surrounding water within about 1 h.

Again, note that this one-sentence summary satisfies the criterion of self-sufficiency: it can be fully understood without reference to the paper it summarizes. The critique follows.

Saul Tee
Bio 101
April 2, 2001

Kĩnehcép, N.A. 1982. Ability of some gastropod egg capsules to protect against low-salinity stress. *J. Exp. Marine Biol. Ecol.* 63: 195–208.

The fertilized eggs of marine snails are often enclosed in complex, leathery egg capsules with 30 or more embryos being con-

fined within each capsule. The embryos develop for 1 or more weeks before leaving the capsules. The egg capsules of intertidal species potentially expose the developing embryos to thermal stress, osmotic stress, and desiccation stress. This paper (Kînehcép, 1982) describes the ability of such egg capsules to protect developing embryos from low-salinity stress, such as might be experienced at low tide during a rainstorm.

Two snail species were studied: *Nucella lamellosa* and *N. lima*. Embryos were exposed, at 10–12°C, either to full-strength seawater (control conditions) or to 10–12% seawater solutions (seawater diluted with distilled water). The ability of egg capsules to protect the enclosed embryos from low-salinity stress was assessed by placing intact egg capsules into the test solutions for up to 9 h, returning the capsules to full-strength seawater, and comparing subsequent embryonic mortality with that shown by embryos removed from capsules and exposed to the low-salinity stress directly.

Encapsulated embryos exposed to the low salinities suffered less than 2% mortality, even after low-salinity exposures of 9 h duration. In contrast, embryos exposed directly to the same test conditions for as little as 5 h suffered 100% mortality. All embryos survived exposure to control conditions for the full 9 h, showing that removal from the capsules was not the stress killing the embryos in the other treatments. Sampling capsular fluid at various times after capsules were transferred to the diluted seawater, Kînehcép found that the concentration of solutes within capsules fell to near that of the surrounding water within about 1 h after transfer.

This study clearly demonstrates the protective value of the egg capsules of 2 snail species faced with low-salinity stress. However, Kînehcép was unable to explain how egg capsules of these 2 species protect the enclosed embryos since the capsules did not prevent decreases in the solute concentration of the capsular fluid. Although Kînehcép plotted the rate at which the solute concentration falls within the capsules (his Fig. 1), he sampled only at 0, 60, and 90 min after the capsules were transferred to water of reduced salinity. I think he should have sampled at frequent intervals during the first 60 min to discover how rapidly the solute concentration of the capsule fluid falls. As Kînehcép himself suggests, perhaps the embryos are less stressed if the concentration inside the capsule falls slowly. These experiments were all performed at a single temperature even though encapsulated embryos are likely to experience fluctuation in both temperature and salinity as the tide rises and falls during the day; the study should be repeated using a range of temperatures likely to be experienced in the field. In addition, I suggest repeating these experiments using deep-water species whose egg capsules are never exposed to salinity fluctuations of the magnitude used in this study.



## Analysis of Student Critique

As before, this student begins with just enough introductory information to make the point of the study clear and ends the first paragraph with a succinct statement of the researcher's goal. The methods and results of the study are then briefly reviewed, as in a summary. Whereas a summary would probably end at this point, the critique continues with thought-provoking assessments by the student. Note that the student was careful to distinguish his thoughts from those of the paper's author (see pp. 30–33, on plagiarism).

# CONCLUDING THOUGHTS

Clearly, successfully completing either type of assignment is no trivial matter. But preparing good summaries and critiques is an excellent way to push yourself toward true understanding of what you read—and of the nature of scientific inquiry.