CHAPTER 2

Research article structures

We will now look at the overall structure of research articles in science. In general, this follows a set of conventions that have developed over the years from 1665, when the first issue of *Philosophical Transactions* appeared in England. It is important to recognize that, within a common core structure, there are variations from field to field and from journal to journal: always check the specific requirements of your target journal before finalizing the structure of any article you write.

Before we look at the results of research into article structure, complete the introductory task below.

Task 2.1 Article headings and subheadings

Read quickly to find the headings of the sections of the PEAs (Chapters 18 and 19):

- How is each paper organized?
- What are the main headings and subheadings? Make brief notes.

Check your answers in the Answer pages.

Now look at the headings of your SA (a Selected Article from your own research field) and the SA of a colleague. Note the similarities and differences you find.

2.1 Conventional article structure: AIMRaD (Abstract, Introduction, Materials and methods, Results, and Discussion) and its variations

Before we explore article structure in detail, it is important to note that our focus in this book is on research articles based on experimental research. Other research paradigms, for example in humanities and social science fields, use different structures for their papers. Similarly, papers other than research articles use different structures. Of particular relevance to scientists are review articles (or reviews), which do not present new data from fresh experimentation, but rather selectively discuss and compare the findings of other scientists, in order to advance thinking in the area of interest. We will think more about these other types of scientific article in later subsections. First, we will consider the hourglass

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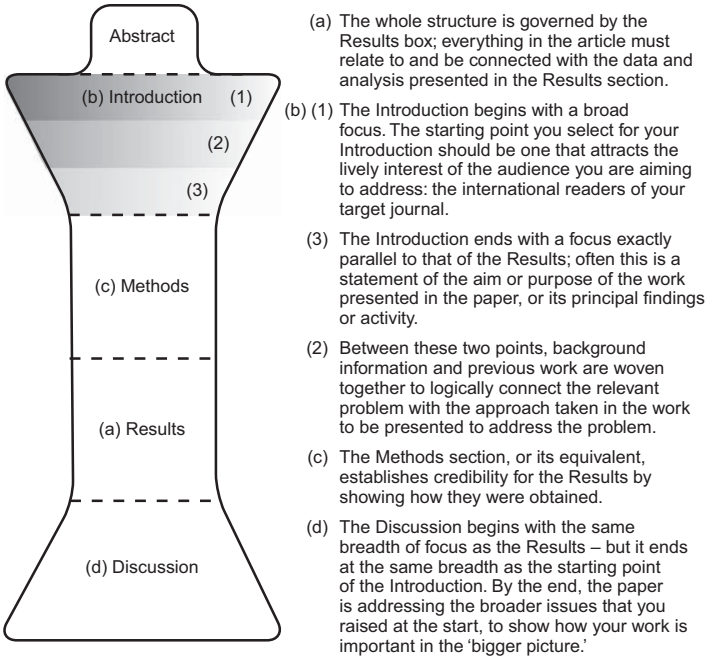

Fig. 2.1 AIMRaD: the hourglass "shape" of a generic scientific research article and key features highlighted by this shape.

diagram (Figure 2.1) commonly used to represent the structure of an AIMRaD article, and what it can tell us about English-language research articles. In this diagram, it is the width and shape of the segments, rather than their depth, that tell us something important about scientific articles.

Here we represent an experimental article in terms of different component shapes put together into an hourglass configuration. This enables us to highlight several important features of such articles in a way that is easy to remember. The right-hand part of Figure 2.1 summarizes the features to focus on at this stage.

Task 2.2 Does the diagram match your understanding?

Discuss: Does this hourglass shape also represent the understanding of a research article in your culture or workplace? If not, can you suggest a diagram that shows how your understanding of a research article is different?

Of course, not all scientific research articles follow the simple structure given in Figure 2.1. There are two major variations that we will introduce here; these are presented visually in Figures 2.2 and 2.3. Study these figures now, before doing Task 2.3.

Other research article formats

The highly cited journals *Nature* (UK) and *Science* (USA) use variations of the common conventions for their article categories, reflecting the fact that their aim

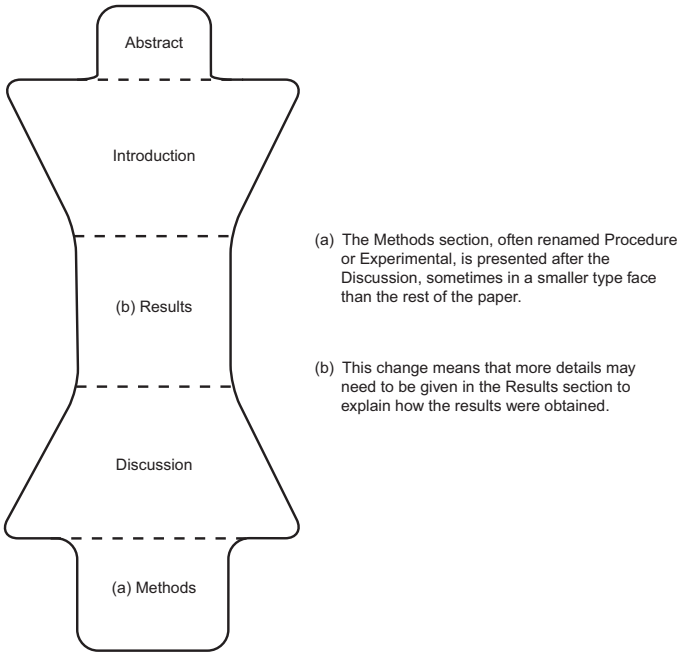

Fig. 2.2 AIRDaM (Abstract, Introduction, Results, Discussion, and Methods and materials): a structure variation that occurs in articles in some journals with a focus on molecular biology.

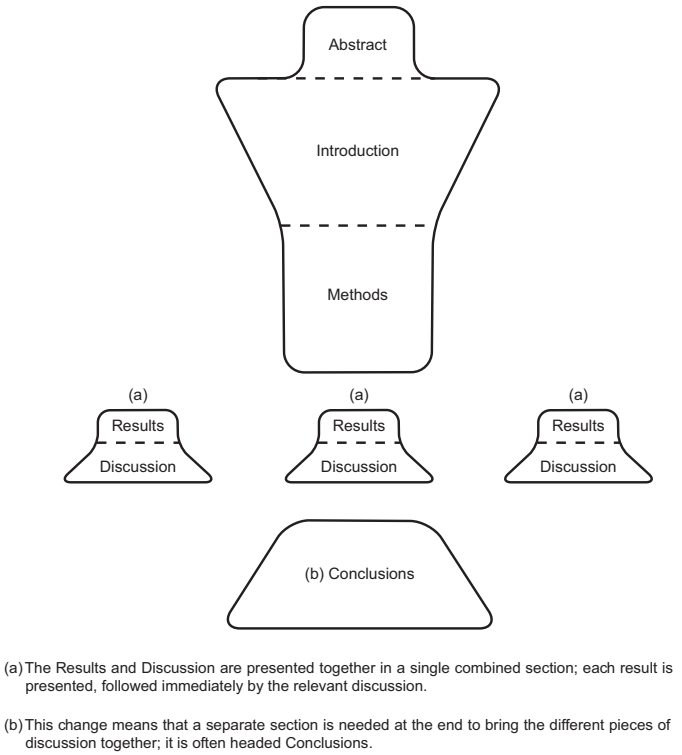

Fig. 2.3 AIM(RaD)C (Abstract, Introduction, Materials and methods, repeated Results and Discussion, Conclusions): a structure variation that is permitted in some journals, usually for shorter articles.

Task 2.3 Structure of the PEAs

Check the notes you made in answer to Task 2.1.

- Which of the three structures presented so far matches most closely the structure of the PEAs? (Check your answer in the Answer pages.)
- Which most closely matches your SA?

is to present highly significant new advances in science in ways that are very accessible to scientists who are not necessarily specialists in the areas covered by the articles. These articles typically begin with a carefully structured initial section introducing the background and rationale of the work to the wide range of expected readers, followed by a concise report of the findings and a short discussion. Methods are often only summarized in the main article, with full details appearing on a linked website. Full details on the structures required by these journals can be found on the journals' websites. Competition for publication in these journals is intense, and they are not likely to be realistic targets for most beginning scientists. For this reason we do not focus on their structure in this book.

Many journals offer alternatives to the article format for reporting research findings. Important among these are brief notes (also called research notes or notes), and letters. These may not include any section headings at all, but if you read them with an analytical eye you will be able to find the same types of information as are contained under the conventional AIMRaD headings in a full article.

Task 2.4 Prediction

Identify which part of a research paper the following phrases came from. Write one of the following letters at the end of each line: I = Introduction, M = Materials and methods, R = Results, or D = Discussion.

Example: It is very likely that . . . because . . .	(D)
. . . yielded a total of . . .	( )
The aim of the work described . . .	( )
. . . was used to calculate . . .	( )
There have been few long-term studies of . . .	( )
The vertical distribution of . . . was determined by . . .	( )
This may be explained by . . .	( )
Analysis was carried out using . . .	( )
. . . was highly correlated with . . .	( )

Check your answers in the Answer pages.

Now we begin to think in more detail about what information appears in the different sections of a research article. It is likely that you already know quite a lot about this, from reading articles for your own work. Task 2.4 focuses on this pre-existing knowledge.

It is likely that the clues you used to help you answer the questions in Task 2.4 related both to the vocabulary in the phrases and to elements of the grammar,

especially the tense of the verbs (simple past, present perfect). We will build on this knowledge in later sections.

In Chapter 3 we will consider the relationship between the structure of research articles and the expectations of the gatekeeper audience that you, as an article submitter, are aiming to meet. The conventional structures we have been looking at in Section 2 have been maintained in science journals for a long time: we can assume that they must still serve the purposes of the journal editors effectively, and meet the needs of the journal readers. It is interesting to think about how and why that is the case.