Academic writing: figures and tables

Figures and tables can be used to describe **complex or large amounts of information**. At the moment you realize that **words will be unable to convey your message** (or you would need many words), take this as a sign that you have to introduce a figure or table. You can also use tables and figures to draw attention to particular findings (e.g., a relationship between variables.

Description

Figures and tables are intended to clarify complex information to the reader. We distinguish two types of information:

- Quantitative information: graphs and tables can clarify relationships between different variables;
- Qualitative information: figures (photos, drawings, diagrams) and tables can clarify or order methods and concepts.

Guidelines – general (figures and tables)

1. Think about how you want to present your data: what is the aim? Quantitative data can be shown in a table or figure, depending on the aim. Choose a table if you want to show the actual values, but choose a figure (e.g., line chart) if you want to emphasize a pattern or relations between variables, e.g., an interaction or a change in values over time. Do not present the **same information** in both a figure and a table.

2. **Carefully select** your figures and tables: only include them when they are needed for your story. Additional figures or tables can be put in appendices.

3. **Carefully construct** your figures and tables: figures that are OK to explore your data during research are usually not appropriate to include in your report.

4. Figures and tables are **positioned** close to where their information is used, but they are not part of a sentence - they should 'float' (usually to the top or bottom of the page).

5. Figures and tables should be positioned and **numbered** in the order that they appear in the text. Numbering of figures and tables are separate, i.e. the first table is called Table 1, even if there is already a Figure 1. In a report, illustrations may be numbered by chapter (e.g. "Figure 2.1"). Use the automatic numbering option of your word processor to ensure synchronization of the numbering of illustrations and the numbers occurring in the references in the text.

6. If a figure consists of sub figures (panels) those are numbered 'a', 'b' etc (e.g. Figure 4a). The sub figure letter should be displayed in, above, or to the left of the sub figure. In the caption each sub figure should be referenced.

7. All types of figures (including photos, graphs, drawings) are called 'Figure' and follow the same numbering.

8. All figures and tables need **captions**. The caption starts with the illustration type ('Figure' or 'Table') followed by the number. Spend one sentence to clarify the function of the figure/table: what does it represent and why did you include it. Spend the other sentence(s) to give information about how to read the figure, for example: "Winter data are plotted in the figure a) and summer data in figure b).". A reader should be able to understand the figure without reading the report. The caption does not contain interpretation and analysis. **Captions are placed** *below* **figures and** *above* **tables.**

9. Each figure or table should be **referenced** in the text at least once. When referring to figures, use "Figure 1" at the beginning of a sentence, otherwise "Fig. 1". "Table" cannot be abbreviated.

10. **Inform** the reader about what the figures and tables demonstrate: they never speak for themselves. Do not 'dump' figures and tables. However, do not repeat the contents of the tables and figures in the main text.

11. When **interpreting** (discussing) the figure or table in the text, do not repeat the information in the illustration. Rather, use it as a reference to make statements, e.g. "Southern wind is the dominant wind direction (Fig. 4a).". This indirect citation is more concise than "From Fig. 4a we can conclude that…" or Fig. 4a shows…" Discuss or highlight trends, remarkable results and results vs. expectations. The amount of text devoted to a figure should be in line with the complexity of the figure.

12. If you use **figures from others**, first ensure that *their* figure really conveys the exact information *you* need (no more, no less). If not,

consider to make your own. If you still decide to use theirs, put a reference in the caption ("(from Smith et al., 2018)"). If you use someone else's figure as inspiration for your own, reference as well ("(after Smith et al., 2018)").
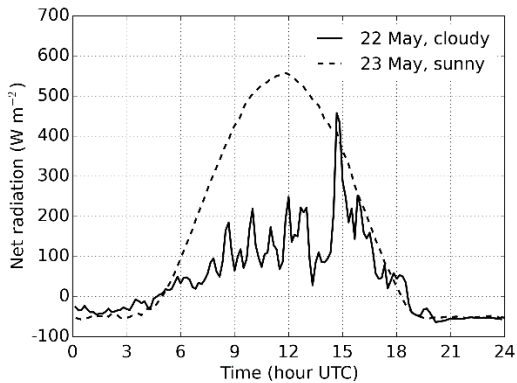

Figure 1: Example of a line plot. Points are connected because the independent variable is continuous. The line types are sufficiently different and font size is comparable to that of text.

Guidelines – graphs (quantitative)

Use graphs when:

- presenting values that follow a pattern or trend (or do not follow a trend, contrary to your hypotheses); adding a trend line may help to clarify the trend.
- the exact values are not important.

1. Select the appropriate type of graph:
   a. **Line graph**: shows the relation between a continuous variable on the x-axis and a characteristic variable on the y-axis. Line graph are often used to emphasize patterns such as an interaction or time course, see **Error! Reference source not found.**.
   b. Scatter **plot**: shows the relation between two variables in a dataset (Figure 2);
   c. **Bar graph**: shows the distribution of a data set for categorical variables (discontinuous or countable, e.g. annual sums); often used to compare groups or conditions. Special case: histograms show the frequency of occurrence of given values;
   d. Contour **plot**: shows the dependence of a variable on two independent variables; special cases are horizontal **maps** (e.g. elevation maps) and vertical **cross sections** (also: filled contour plots in which colours are assigned to values);
   e. **Pie chart**: shows the relative contribution of categories to the total.
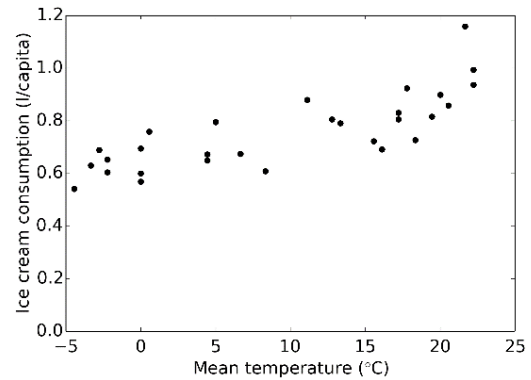

Figure 2: Example of a scatter plot. Dots are sufficiently large, y-axis starts at zero to put trend into perspective.

2. Each **axis** should have a **label**. The label should contain (1) the quantity displayed, and (2) the units. In the case of a contour plot, contours should be labelled and the units of the label should be indicated in the caption. In the case of a filled contour plot, a colour bar should be included that indicates quantity and unit of the dependent variable.
3. Carefully select **axis limits**:
   - if you expect a one-to-one relationship in a scatter plot: same limits for x-axis and y-axis (and make the plot window square);
   - if a zero-value has a clear interpretation, consider to include the zero in the axis, even if the data do not come close to zero;
   - if you have multiple graphs with comparable data, use identical x-ranges and y-ranges for them.
4. Limit the **number of datasets** shown in a single graph; ensure that the reader can distinguish them.
5. In case of multiple datasets in one graph: include a **legend**.
6. Carefully select **symbol** types and **line** types:
   - distinct to enable recognition (preferably with colours that are distinguishable when printed in black/white;
   - large/thick enough to enable visibility;
   - small/thin enough to prevent overlap;
   - be aware that around 5% of males suffers from red-green colour blindness, so avoid as much as possible a combination of these colours. Blue-yellow colour blindness exists as well, but is less common.
7. If a graph (also holds for other figures) consists of **multiple panels**, indicate them clearly. This is always done with small letters in the figure, and each panel is explained in the figure caption. When referring to a panel in the figure, use for example "Fig. 1a".

8. Use approximately the same **font size** for the caption, text in the figure and the written text.
9. Do **not add a title** above a graph. The information on what is shown in the graph should be clear from the axis titles and the caption.
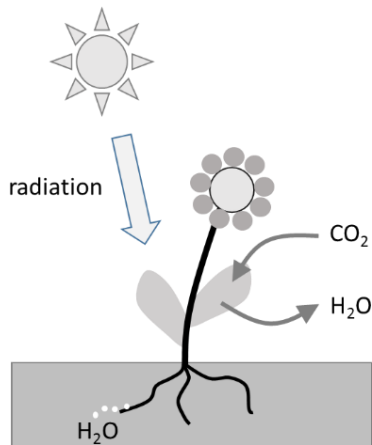

Figure 3: Example of a conceptual figure (in this case to illustrate the macroscopic processes related to photosynthesis).

Guidelines – figures (qualitative)

Use qualitative illustrations to:
- clarify concepts and theory;
- clarify methods and instruments;
- summarize findings.

1. Select the appropriate type of figure:
   a. **Photo**: shows part of reality in full detail (e.g. field conditions, non-standard equipment, a sample);
   b. **Drawing**: shows essentials of a part of reality; advantage over photos is that drawings allow to remove details, emphasize important parts, make cross sections;
   c. **Conceptual picture**: a schematic depiction of a phenomenon or process; it can contain drawings, text, numbers, boxes, arrows etc. (see Figure 3 for an example);
   d. **Flow chart:** shows the steps in a process using boxes and arrows (e.g. to visualize data analysis, research procedures, decision trees).
   e. **Pie chart**: shows the relative contribution of categories to the total. Try to avoid pie charts as they do not allow for easy comparison between datasets; rather use a bar chart.
2. Make sure that the information in the figure is **consistent** with the contents of your report (e.g. in terms of terminology, symbols, numerical values, level of simplification).

Table 1: Example of table with quantitative information; rows ordered by clay content; columns indicate both quantity and unit.

Soil type	Porosity	Saturated conductivity
	cm^3/cm^3	cm/d
Light clay	0.42	1.17
Medium clay	0.60	5.26
Heavy clay	0.55	15.46

Guidelines – tables (quantitative)
(based on Schultz, 2009)

Use quantitative tables when:
- data are too repetitive/complex to discuss in text;
- presenting multiple related variables;
- exact values are important.

1. **Structure** the table in a way compatible with how the reader will use it (usually: a quantity per column, one instances/sample per row). It is easier to compare columns than rows.
2. Put the columns that are most important to **compare** close to each other.
3. Each columns must have a **heading** indicating the content of the column. If the column contains values for a quantity, indicate the units (usually on a separate line in the heading).
4. Columns may be **grouped** when they have something in common; this common property is indicated with an additional line in the column heading (e.g. when you have 3 variables both for winter and for summer: 2 times 3 columns).
5. **Order** rows in some logical way, e.g. alphabetically, by location, time, magnitude (see **Error! Reference source not found.** for an example).
6. **Align** numerical contents of cells by the decimal point.
7. In large tables, indicate to the reader which are the **most important** data (e.g. using boldface, shading).
8. Remove repetitive elements (indicate that they are identical to values is the row or column before). Remove a row or column when all values in it are the same. Constants should be described in the note under the table.
9. Explain abbreviations and symbols in a footnote under the table.
10. Try to fit a table on one page.

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Guidelines – tables (qualitative)

Use qualitative tables to:
- organize important points that are spread out over the text;
- summarize textual information in an ordered way (e.g. when reviewing extensive literature);
- summarize characteristics of instruments, sites or experiments.

1. Qualitative tables also need **column headings**. In case the table contains a mix of qualitative and quantitative data, the units must be given for the quantitative data.
2. Consider if **rows** or columns can be **ordered** in a logical way (e.g. by size, time, alphabet).

Table 2: Example of qualitative table (in this case to summarize the use of various illustration types.

Illustration type	Useful to...
Figure	
– Graph	show relation between variables
– Qualitative	clarify complex concepts, processes or methods
Table	
– Quantitative	present multiple related variables where exact values are important
– Qualitative	summarize complex textual information

Recommended format for numbers that include decimal points:

- As a general rule, numbers usually contain two decimal places. However, the precision of the measurement sometimes requires additional decimal places, for example p = .002.
- Pseudo-exactness should be avoided. Do not use more decimals than your method can justify. E.g., an average of 52.358 kg suggests that you can weigh up to the gram. If you measured in kilos, report an average of 52 kg.
- Be consistent: don't vary the number of decimal places within a variable or table.
- A leading zero is the zero placed before a decimal point. Use the leading zero only if the number can (theoretically) exceed 1.0 (for example, 0.5 hours). If the number can never exceed 1.0 (for example p = .08), you should not include a leading zero (McAdoo, 2010).
- In English texts, use a point as decimal separator; in Dutch texts use a comma.

Reference and further reading

Schultz D.M. (2009) Figures, Tables, and Equations. In: Eloquent Science. American Meteorological Society, Boston, MA (https://doi.org/10.1007/978-1-935704-03-4_11)

McAdoo T. (July 1, 2010). A post about nothing. Retrieved from https://blog.apastyle.org/apastyle/2010/07/a-post-about-nothing.html Last accessed on 16-08-2019