

CHAPTER 16 ---

How to Design Effective Tables

A tabular presentation of data is often the heart or, better, the brain, of a scientific paper.

—Peter Morgan

WHEN TO USE TABLES

Before proceeding to the “how to” of tables, let us first examine the question of “whether to.”

As a rule, do not construct a table unless repetitive data *must* be presented. There are two reasons for this general rule. First, it is simply not good science to regurgitate reams of data just because you have them in your laboratory notebooks; only samples and breakpoints need be given. Second, the cost of publishing tables can be high compared with that of text, and all of us involved with the generation and publication of scientific literature should worry about the cost.

If you made (or need to present) only a few determinations, give the data in the text. Tables 16.1 and 16.2 are useless, yet they are typical of many tables that are submitted to journals.

Table 16.1 is faulty because two of the columns give standard conditions, not variables and not data. If temperature is a variable in the experiments, it can have its column. If all experiments were done at the same temperature, however, this single bit of information should be noted in the materials and methods section and perhaps as a footnote to the table, but not in a column in the table. The data presented in the table can be given in the text itself in a form that is readily comprehensible to the reader, without taking up space with a table. Very simply, these results would read: “Aeration of the growth medium

Table 16.1. Effect of aeration on growth of *Streptomyces coelicolor*

Temp (°C)	No. of expt	Aeration of growth medium	Growth ^a
24	5	+ ^b	78
24	5	—	0

^aAs determined by optical density (Klett unit).
^bSymbols: +, 500-ml Erlenmeyer flasks were aerated by having a graduate students blow into the bottles for 15 min out of each hour; —, identical test conditions, except that the aeration was provided by an elderly professor.

Table 16.2. Effect of temperature on growth of oak (*Quercus*) seedlings^a

Temp (°C)	Growth in 48 h (mm)
–50	0
–40	0
–30	0
–20	0
–10	0
0	0
10	0
20	7
30	8
40	1
50	0
60	0
70	0
80	0
90	0
100	0

^aEach individual seedling was maintained in an individual round pot, 10 cm in diameter and 100 cm high, in a rich growth medium containing 50% Michigan peat and 50% dried horse manure. Actually, it wasn’t “50% Michigan”; the peat was 100% “Michigan,” all of it coming from that state. And the manure wasn’t half-dried (50%), it was all dried. And, come to think about it, I should have said “50% dried manure (horse)”; I didn’t dry the horse at all.

was essential for the growth of *Streptomyces coelicolor*. At room temperature (24°C), no growth was evident in stationary (unaerated) cultures, whereas substantial growth (OD, 78 Klett units) occurred in shaken cultures.”

Table 16.2 has no columns of identical readings, and it looks like a good table. But is it? The independent variable column (temperature) looks reasonable enough, but the dependent variable column (growth) has a suspicious number of zeros. You should question any table with a large number of zeros (whatever the unit of measurement) or a large number of 100s when percentages are used. Table 16.2 is a useless table because all it tells us is that “The oak seedlings grew at temperatures between 20 and 40°C; no measurable growth occurred at temperatures below 20°C or above 40°C.”

In addition to zeros and 100s, be suspicious of plus and minus signs. Table 16.3 is of a type that often appears in print, although it is obviously not very informative. All this table tells us is that “*S. griseus*, *S. coelicolor*, *S. everycolor*, and *S. rainbowensky* grew under aerobic conditions, whereas *S. nocolor* and *S. greenicus* required anaerobic conditions.” Whenever a table, or columns within a table, can be readily put into words, do it.

Some authors believe that all numerical data must be put in a table. Table 16.4 is a sad example. It gets sadder when we learn (at the end of the footnote) that the results were not statistically significant anyway ($P=0.21$). If these data

Table 16.3. Oxygen requirement of various species of *Streptomyces*

Organism	Growth under aerobic conditions ^a	Growth under unaerobic conditions
<i>Streptomyces griseus</i>	+	—
<i>S. coelicolor</i>	+	—
<i>S. nocolor</i>	—	+
<i>S. everycolor</i>	+	—
<i>S. greenicus</i>	—	+
<i>S. rainbowensky</i>	+	—

^aSee Table 16.1 for explanation of symbols. In this experiment, the cultures were aerated by a shaking machine (New Brunswick Shaking Co., Scientific, NJ).

Table 16.4. Bacteriological failure rates

Nocillin	K Penicillin
5/35 (14) ^a	9/34 (26)

^aResults expressed as number of failures/total, which is then converted to a percentage (within parentheses). $P=0.21$.

Table 16.5. Adverse effects of nickleceillin in 24 adult patients

No. of patients	Side effect
14	Diarrhea
5	Eosinophilia (≥ 5 eos/mm ³)
2	Metallic taste ^a
1	Yeast vaginitis ^b
1	Mild rise in urea nitrogen
1	Hematuria (8–10 rbc/hpf)

^aBoth of the patients who tasted metallic worked in a zinc mine.

^bThe infecting organism was a rare strain of *Candida albicans* that causes vaginitis in yeasts but not in humans.

were worth publishing (which seems doubtful), one sentence in the results would have done the job: “The difference between the failure rates—14 percent (5 of 35) for nocillin and 26 percent (9 of 34) for potassium penicillin V—was not significant ($P = 0.21$).”

In presenting numbers, give only significant figures. Nonsignificant figures may mislead the reader by creating a false sense of precision; they also make comparison of the data more difficult. Unessential data, such as laboratory numbers, results of simple calculations, and columns that show no significant variations, should be omitted.

Another very common but often useless table is the word list. Such a list might be suitable for a slide in a presentation, but it does not belong in a scientific paper. Table 16.5 is an example. This information could easily be presented in the text. A good copy editor will kill this kind of table and incorporate the data into the text. Yet, when copy editors do so (and this leads to the next rule about tables), they often find that much or all of the information was already in the text. Thus, the rule: Present the data in the text, or in a table, or in a figure. *Never* present the same data in more than one way. Of course, selected data can be singled out for discussion in the text.

Tables 16.1 to 16.5 provide typical examples of the kinds of material that should not be tabulated. Now let us look at material that should be tabulated.

HOW TO ARRANGE TABULAR MATERIAL

Having decided to tabulate, you ask yourself the question: “How do I arrange the data?” Since a table has both left-right and up-down dimensions, you have

two choices. The data can be presented either horizontally or vertically. But *can* does not mean *should*; the data should be organized so that the like elements read *down*, not across.

Examine Tables 16.6 and 16.7. They are equivalent, except that Table 16.6 reads across, whereas Table 16.7 reads down. To use an old fishing expression, Table 16.6 is “bass ackward.” Table 16.7 is the preferred format because it allows the reader to grasp the information more easily, and it is more compact and thus less expensive to print. The point about ease for the reader would seem to be obvious. (Did you ever try to add numbers that were listed horizontally rather than vertically?) The point about reduced printing costs refers to the fact that all columns must be wide or deep in the across arrangement because of the diversity of elements, whereas some columns (especially those with numbers) can be narrow without runovers in the down arrangement. Thus, Table 16.7 appears to be smaller than Table 16.6, although it contains the same information.

Table 16.6. Characteristics of antibiotic-producing *Streptomyces*

Determination	<i>S. fluoricolor</i>	<i>S. griseus</i>	<i>S. coelicolor</i>	<i>S. nocolor</i>
Optimal growth temp (°C)	−10	24	28	92
Color of mycelium	Tan	Gray	Red	Purple
Antibiotic produced	Fluoriccillinmycin	Streptomycin	Rholmondelay ^a	Nomycin
Yield of antibiotic (mg/ml)	4,108	78	2	0

^aPronounced “Rumley” by the British.

Table 16.7. Characteristics of antibiotic-producing *Streptomyces*

Organism	Optimal growth temp (°C)	Color of mycelium	Antibiotic produced	Yield of antibiotic (mg/ml)
<i>S. fluoricolor</i>	−10	Tan	Fluoriccillinmycin	4,108
<i>S. griseus</i>	24	Gray	Streptomycin	78
<i>S. coelicolor</i>	28	Red	Rholmondelay ^a	2
<i>S. nocolor</i>	92	Purple	Nomycin	0

^aWhere the flying fishes play.

Words in a column are lined up on the left. Numbers are lined up on the right (or on the decimal point). Table 16.7, for example, illustrates this point.

Table 16.8 is an example of a well-constructed table. It reads down, not across. Its title and headings are clear enough for readers to understand the data without referring to the text. Items in the body of the table appear in a logical

Table 16.8. Hospitalizations and total charges for neglected tropical diseases and malaria, United States, 2003–2012*

Disease	Hospitalizations		Total charges	
	No. (SE)	95% CI	US\$, millions (SE)	95% CI
Cysticercosis	23,266 (778)	21,741–24,792	1,149 (56)	1,039–1,259
Malaria	14,319 (434)	13,469–15,169	387 (18)	351–423
Echinococcosis	3,919 (170)	3,586–4,252	206 (16)	174–237
Soil-transmitted helminth-associated infections	3,256 (151)	2,959–3,552	201 (19)	162–239
Dengue	2,644 (135)	2,379–2,909	89 (9)	70–107
Leprosy	2,055 (135)	1,791–2,319	94 (9)	76–111
Lymphatic filariasis	1,836 (106)	1,629–2,044	86 (9)	68–103
Schistosomiasis	1,811 (120)	1,576–2,046	101 (12)	78–125
Chagas disease	1,686 (151)	1,389–1,982	118 (17)	84–152
Leishmaniasis	1,022 (92)	841–1,203	52 (7)	38–66
Trachoma	649 (69)	514–784	20 (4)	13–28
Foodborne trematode– associated infections	610 (60)	492–729	41 (7)	28–54
Onchocerciasis	380 (47)	287–473	29 (12)	5–53
Yaws	161 (28)	106–216	7 (2)	3–11

*National estimates were determined on the Nationwide Inpatient Sample by using diagnostic codes from the International Classification of Diseases, 9th Revision, Clinical Modification. A complete list of ICD-9-CM codes used in this study is provided in the online Technical Appendix (wwwnc.cdc.gov/EID/article/21/6/14-1324-Techapp1.pdf)

Source: O'Neal SE, Flecker RH. Hospitalization frequency and charges for neurocysticercosis, United States, 2003–2012. *Emerg. Infect. Dis.* 21:969–976, 2015. Available at <http://wwwnc.cdc.gov/eid/article/21/6/pdfs/14-1324.pdf>. Accessed August 27, 2015.

order. The footnote provides supplementary information on how the data were obtained rather than repeating excessive methodological detail.

Note that these tables have three horizontal rules (lines) but no vertical rules. Virtually all tables are constructed this way. Occasionally, straddle rules (as below “Hospitalizations” and “Total charges” in Table 16.8) are used. Vertical rules normally are not used in tables.

EXPONENTS IN TABLE HEADINGS

If possible, avoid using exponents in table headings. Confusion has resulted because some journals use positive exponents and some use negative exponents to mean the same thing. For example, some have used “cpm $\times 10^3$ ” to refer to thousands of counts per minute, whereas others have used “cpm $\times 10^{-3}$ ” for the same thousands of counts. If it is not possible to avoid such labels in table headings (or in figures), it may be worthwhile to state in a footnote (or in the figure legend), in words that eliminate the ambiguity, what convention is being used.

FOLLOWING THE JOURNAL'S INSTRUCTIONS

Instructions to authors commonly include a section about tables. Before preparing your tables, check the instructions to authors of your target journal. These instructions may indicate such items as the dimensions of the space available, the symbols or form of lettering for indicating footnotes to tables, and the electronic tools to use in preparing tables. Looking at tables in the journal as examples also can aid in preparing suitable tables.

Style manuals in the sciences provide guidance in preparing not only text but also tables and figures. If your target journal specifies a style manual that it follows, consult it in this regard. Even if the journal does not specify a style manual, looking at one relevant to your field can aid in preparing effective tables and figures.

Traditionally, journals have asked authors to submit each table on a separate page at the end of the text. In addition, some journals have said to identify in the margin of the text the first mention of each table, for example, by writing “Table 3” and circling it. This procedure helps ensure that the author has indeed cited each table in the text, in numerical order. It also indicates to the compositor, at the page makeup stage, where to break the text to insert the tables. Today, some journals ask authors to embed tables in the text near their first mention. And some journals ask authors to submit tables as separate files. To determine whether tables should be placed within the text, placed at the

end, or provided in separate files (and to determine how, if requested, to indicate their placement), consult the instructions to authors.

TITLES, FOOTNOTES, AND ABBREVIATIONS

The title of the table (or the legend of a figure) is like the title of the paper itself. That is, the title or legend should be concise and not divided into two or more clauses or sentences. Unnecessary words should be omitted.

Give careful thought to the footnotes to your tables. If abbreviations must be defined, you often can give all or most of the definitions in the first table. Then later tables can carry the simple footnote: "Abbreviations as in Table 1."

Note that "temp" (Tables 16.1, 16.2, 16.6, and 16.7) is used as an abbreviation for "temperature." Because of space limitations in tables, almost all journals encourage abbreviation of certain words in tables that would not be abbreviated in the text. Capitalize any such abbreviations used as the first word in a column heading; do not use periods (except after "no.," which might be misread without the period). To identify abbreviations that your target journal considers acceptable in tables, you can look at tables published in the journal. Also, some journals list in their instructions to authors the abbreviations that can be used without definition in tables that they publish.

ADDITIONAL TIPS ON TABLES

The following are some further tips to help ensure that you design and use tables effectively.

Use wording that will be clear without reference to the text. For example, a table should not just refer to "Group 1" and "Group 2." Rather, it should identify each group by a more meaningful designation (examples: "High-Dose Group" and "Low-Dose Group," "REM Sleep Group" and "NREM Sleep Group," and "Graduate Students" and "Professors").

If a paper includes a series of tables presenting analogous data, use an analogous format for each. For example, if several tables compare the same four groups from different standpoints, list the four groups in the same order in each table. Or if different tables present data on the same variables at different times, keep listing the variables in the same order. Such consistency saves readers effort. (And it is easier for you, too.)

Finally, remember to mention every table in the text. Do so as soon as readers are likely to want to see the table. You have gone to the effort of preparing good tables. Be sure that readers can benefit fully from them.