Lecture 10
Designing figures and tables

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Figures and tables matter!

- Figures and tables convey facts, ideas, and relationships more clearly and concisely than descriptive text;
- Figures and tables are one of the first part of a scientific paper that is reviewed by the editors and readers;

When to use tables?

- Tables are used to display data that are not easily described in the text;
- If there are only few numbers or the message conveyed by the table can be described easily in text, a table should not be used.

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

Patterns can be desribed using text easily

Table 16.4. Bacteriological failure rates

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

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

Too few data to be worth a table

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

Constant repetitive information does not need to be in the figure

Organizing tables

- Organize the table such that it is easy to read;
- List results intended for comparison vertically is preferred;

Table 16.6. Characteristics of antibiotic-producing *Streptomyces*

Determination	*S. fluoricolor*	*S. griseus*	*S. coelicolor*	*S. nocolor*
Optimal growth temp (°C)	–10	24	28	92
Color of mycelium	Tan	Gray	Red	Purple
Antibiotic produced	Fluoricillinmycin	Streptomycin	Rholmondelay[a]	Nomycin
Yield of antibiotic (mg/ml)	4,108	78	2	0

[a]Pronounced "Rumley" by the British.

Table 16.7. Characteristics of antibiotic-producing *Streptomyces*

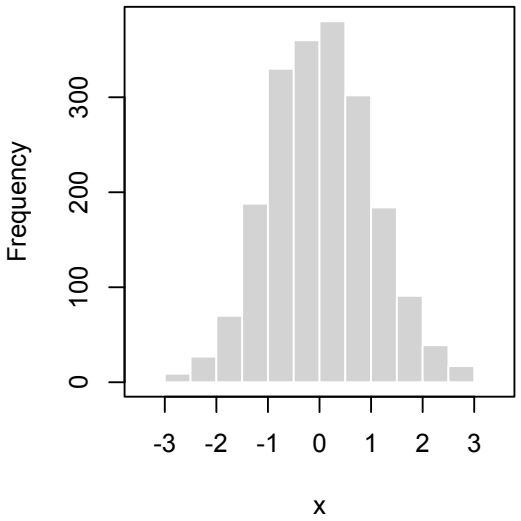
Organism	Optimal growth temp (°C)	Color of mycelium	Antibiotic produced	Yield of antibiotic (mg/ml)
S. fluoricolor	–10	Tan	Fluoricillinmycin	4,108
S. griseus	24	Gray	Streptomycin	78
S. coelicolor	28	Red	Rholmondelay[a]	2
S. nocolor	92	Purple	Nomycin	0

[a]Where the flying fishes play.

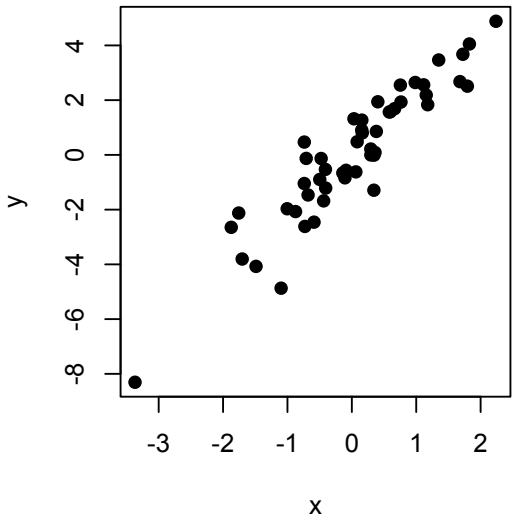
Forms follows function

- Choose a figure type based on the data type;
- Use proper type of figure to convey the intended message.

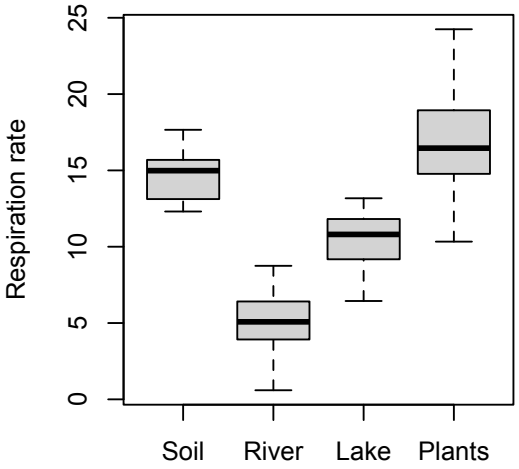
Histogram: show statistical distribution



Scatter plot: show bivariate relationship



Boxplot: show comparison across categories



Strive for clarity

- Figures should be self contained, i.e., the readers do not need to read the text to understand what is on the figure.

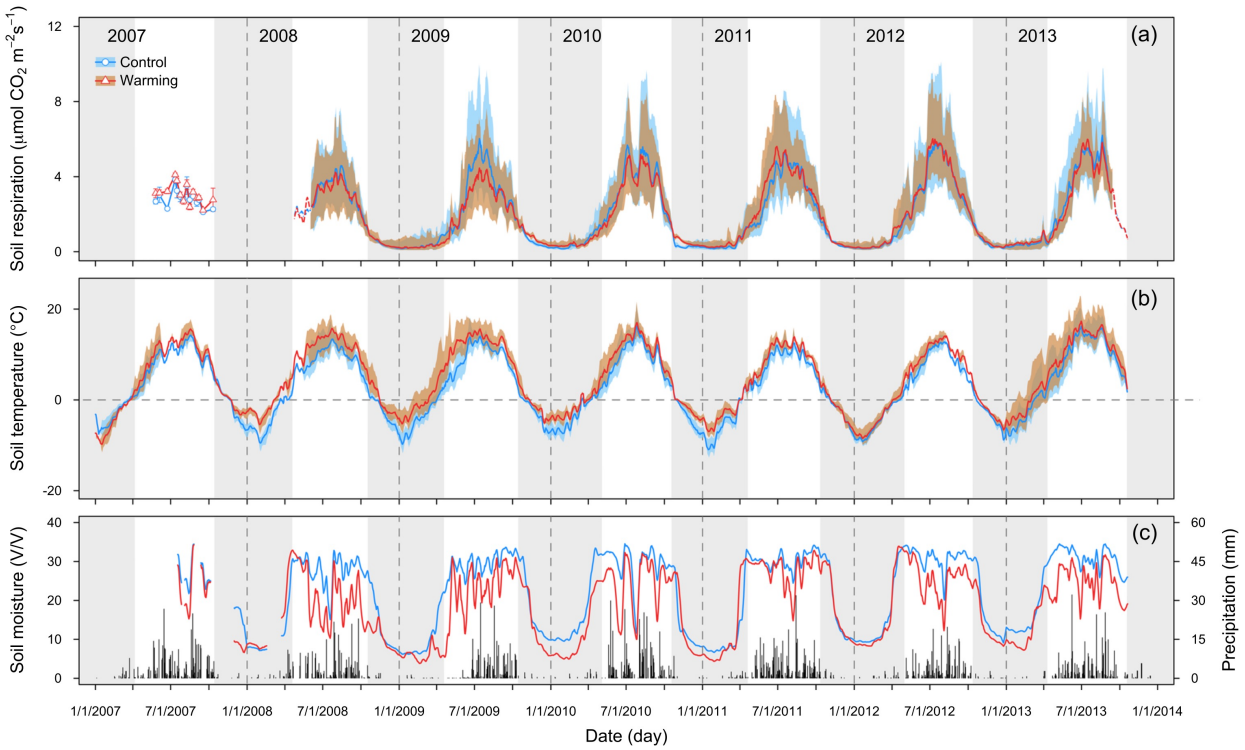
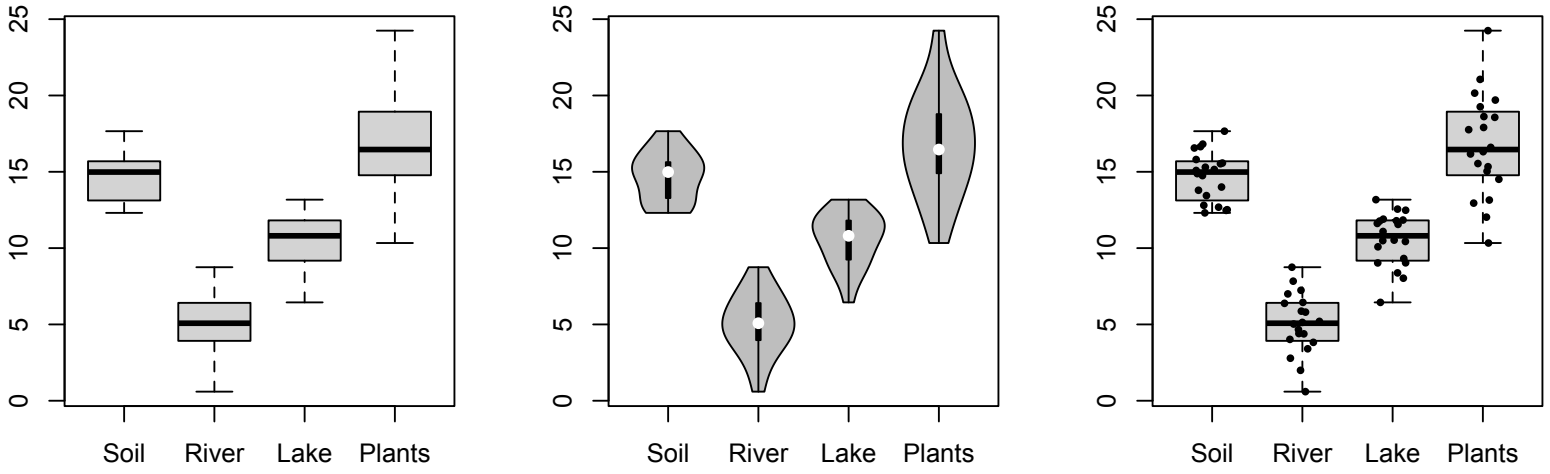


Fig. 1 Seasonal and annual variations in soil respiration (**a**), soil temperature at 5 cm depth (**b**), soil moisture at 5 cm depth and precipitation (**c**) in the in-situ warming experiment. Colored lines represent smoothed (7-days running mean) times series of soil respiration, soil temperature and moisture at 5 cm depth under control (blue) and warming (red) treatments. Times series of soil respiration and soil temperature also shown as colored areas between smoothed (7-days running mean) daily maximum and smoothed (7-days running mean) daily minimum values. The blank and shading periods represent growing seasons and non-growing seasons, respectively

(Wang et al. 2021 Plant and Soiil)

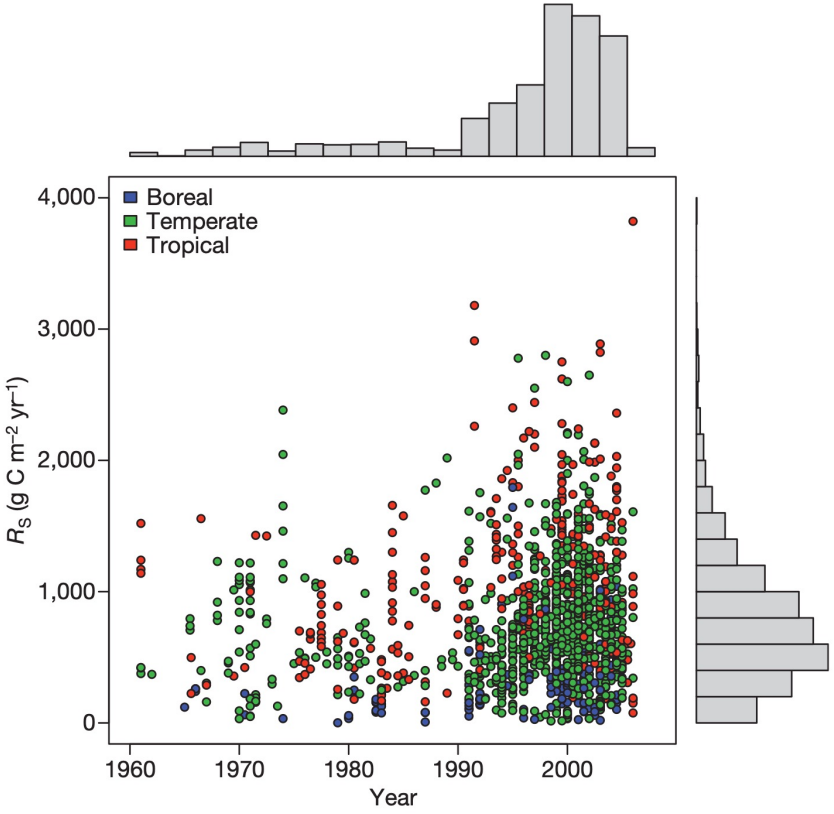
Be informative

- While figures is necessarily a summary of the data, it is often useful to show as much raw data as possible;
- This is often the case for showing distribution of data;

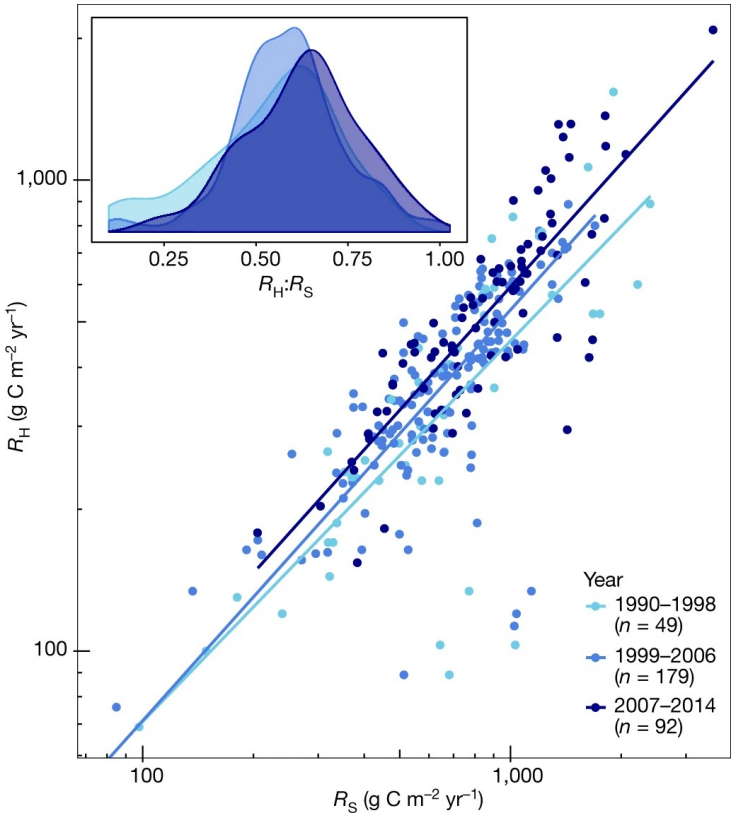


Addressing complexities

- Combining multiple types of graphs in one figure could be an effective way for visualization.



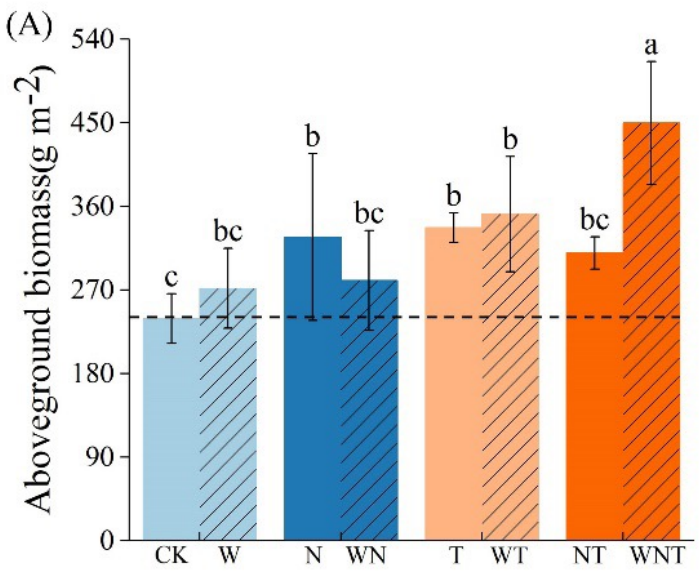
(Bond-Lamberty and Thompson. 2010 Nature)



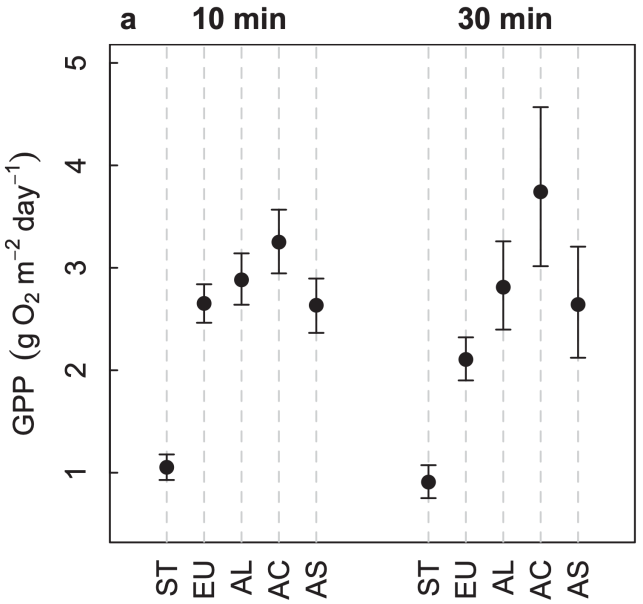
(Bond-Lamberty et al. 2018 Nature)

Avoid redundancy

- Each element in the figure should have a purpose. Design elements that does not have any meaning should be eliminated;
- Unnecessary coloring or lines in the figure can be removed;



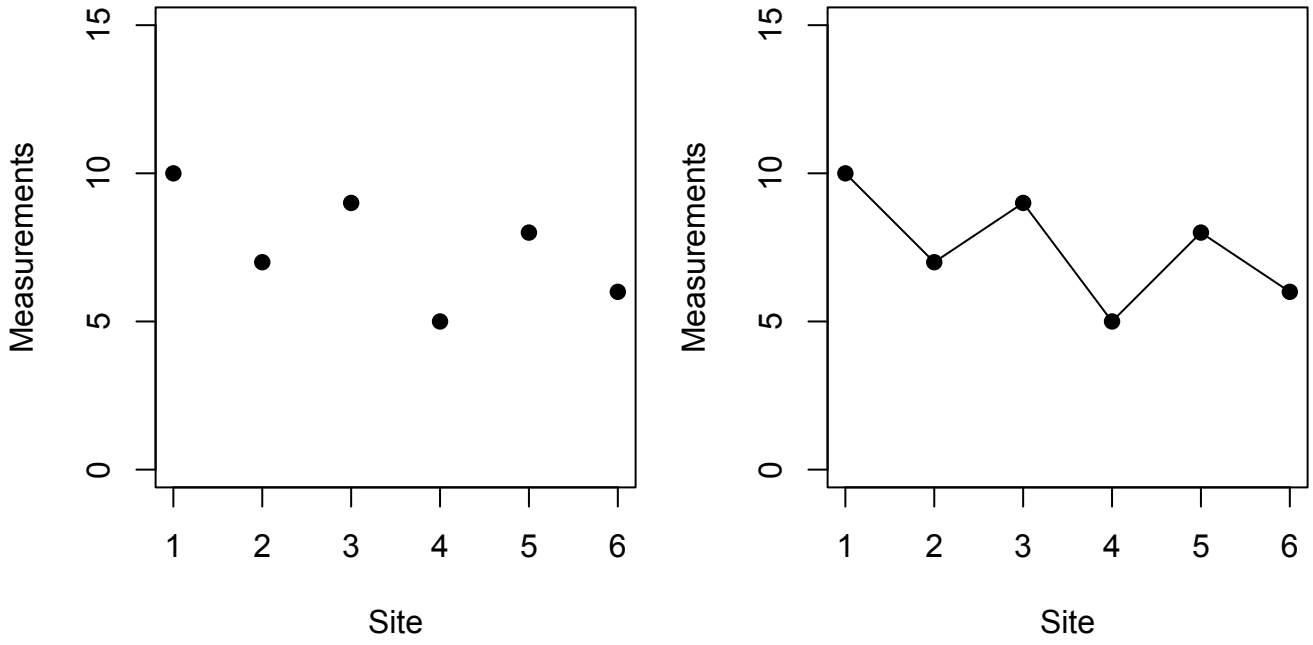
Redundant color



Redundant lines

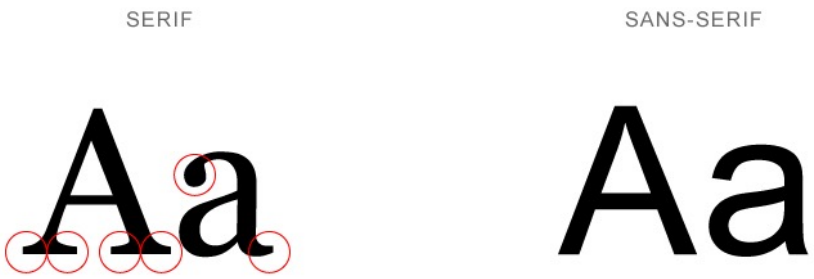
Avoid redundancy

- When plotting values over categories, no need to connect the points with lines if there is no data in between.



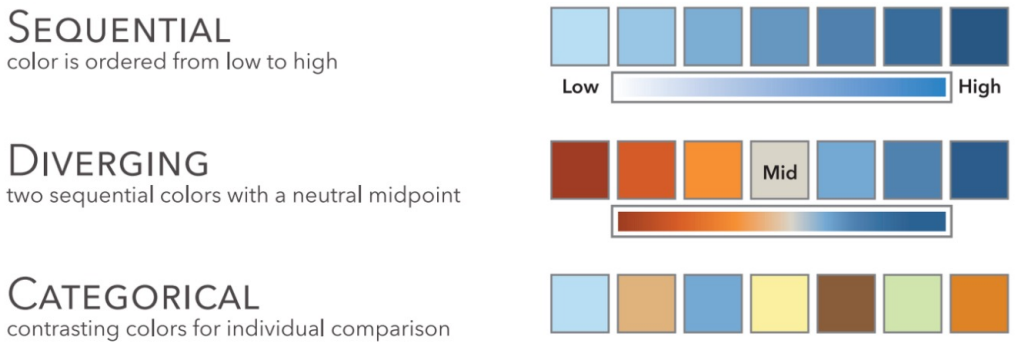
Typography

- Serif is commonly used for large blocks of text. Sans serif is often used for titles, labels, and annotating figures;
- This becomes a convention because sans serif is more legible when printed in small size.
- **Use sans serif fonts**, e.g., Arial, Helvetica, in figures.



Color scheme

- Color scheme should be chosen to reflect the nature of the data;
- **Sequential scheme**: represents ordered data that progress from low to high;
- **Diverging scheme** put equal emphasis on mid-range and extremes at both ends of the data range. It is most effective when the class breaks at the middle.
- **Qualitative scheme** represents categories and does not imply magnitude differences.



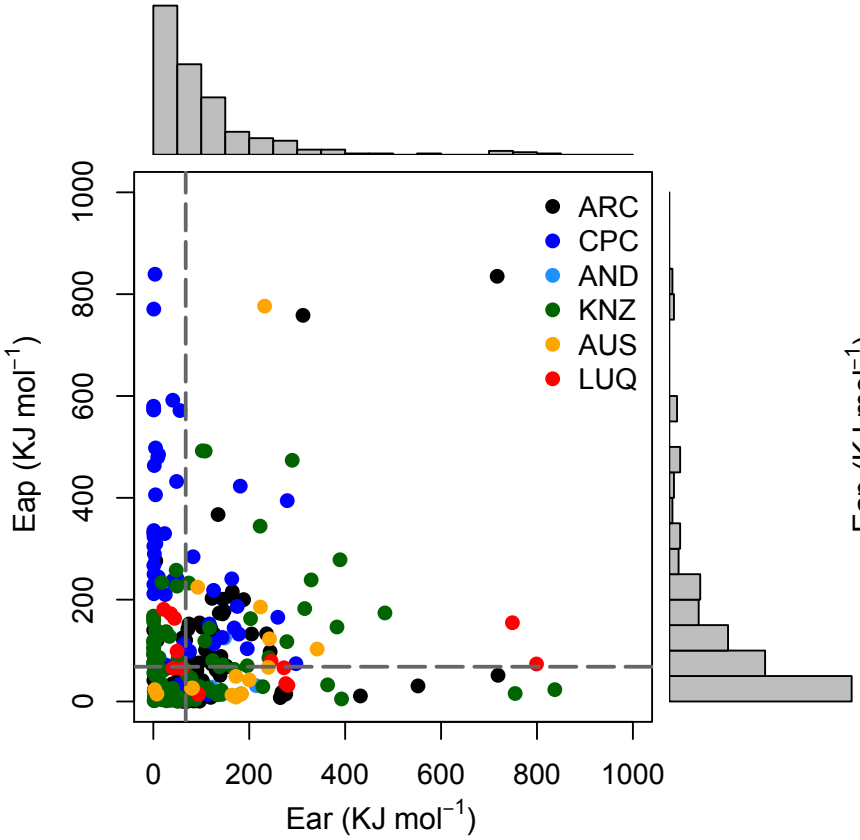
Color scheme

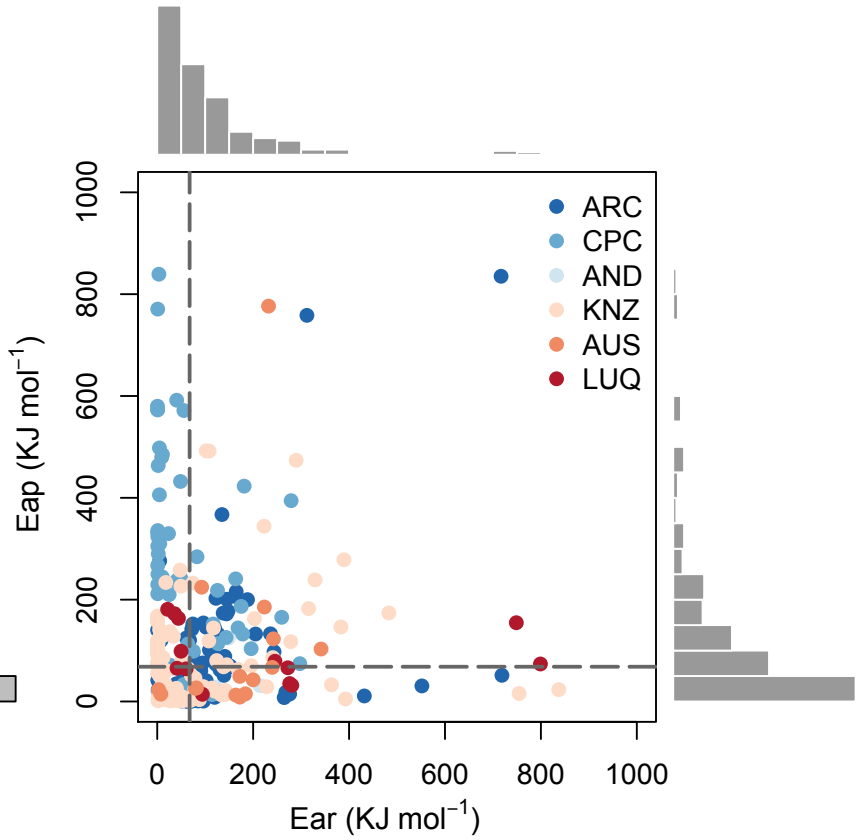
- Other considerations when choosing color schemes
  - **Colorblind safe**: color scheme that does not confuse red-green color blindness;
  - **Print friendly**: RGB colors for digital figure and CMYK colors for printing;
  - **Photocopy friendly**: color scheme that withstand black and white photocopy. Diverging scheme usually does not work for black and white photocopy.

- Use tools to guide your color choice:
  - https://colorbrewer2.org/
  - https://www.color-hex.com

Color scheme

- Example: changing color scheme to make it colorblind friendly and printing friendly.



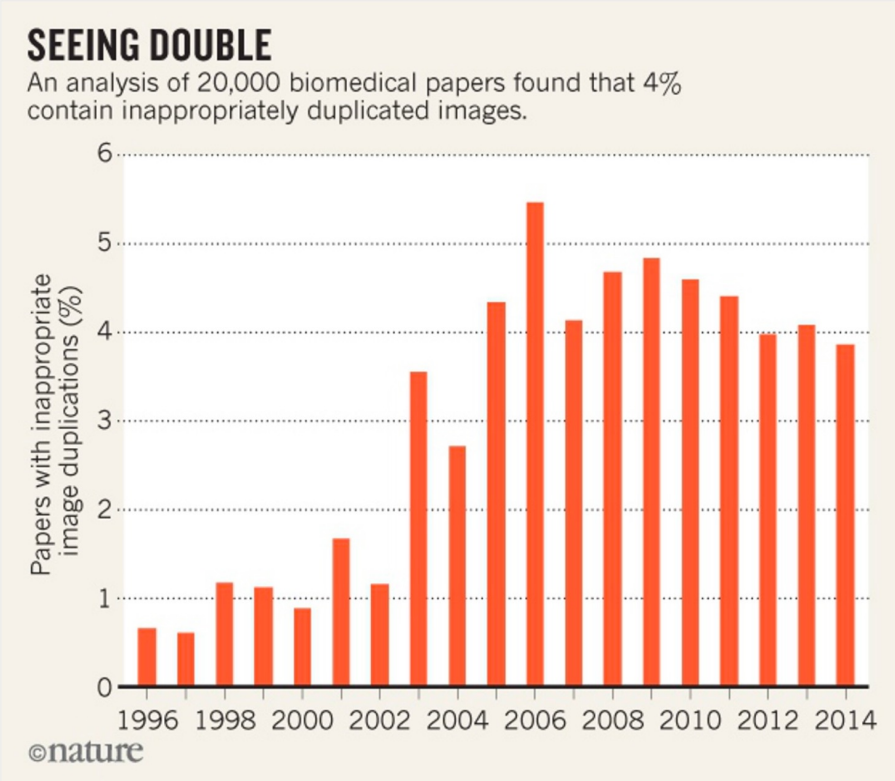


Graph quality

- Figures should have sufficient resolution for good publication quality;
- Line charts or scatter plots can be made as vector graphics; Vector graphics can be scaled up or down without losing quality;
- Typically, image should be made between 600 to 900 ppi.
- Pay attention to journal requirements.

Avoid image manipulation

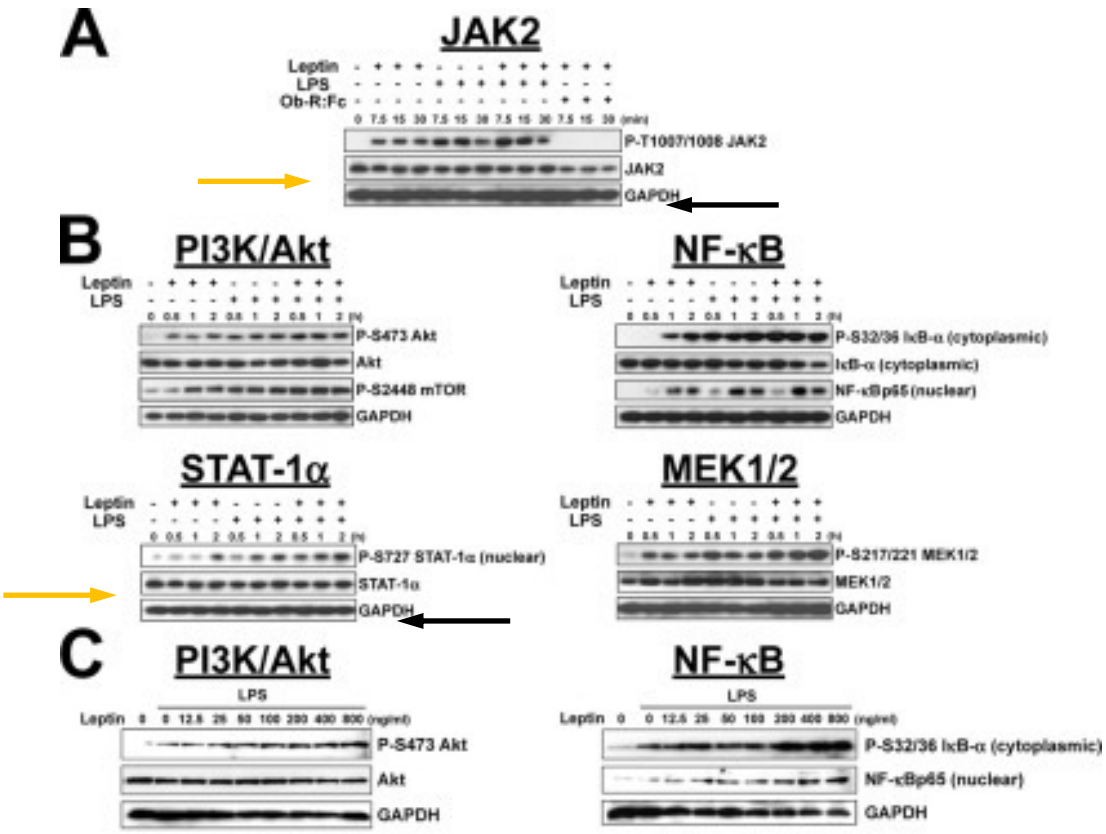
- Inappropriate image resulting from duplication and manipulation is a major issue in many fields of research.



(Bakerr 2016 Nature, based on data from Bik et al. 2018, Molecular and Cellular Biology)

Avoid image manipulation

- Example: inappropriate and unexplainable image duplication led to retraction of the paper.



(Lam et al. 2007 Journal of Biological Chemistry, retracted)

Avoid image manipulation

- Specific features within an image should not be enhanced, obscured, removed, moved, or added;
- Adjustments to brightness or contrast are only acceptable if they apply equally across the entire image and to control;
- Excessive manipulations, such as processing to emphasize one region in the image at the expense of others, are inappropriate;
- Nonlinear adjustments or deleting portions of a recording must be disclosed in a figure legend;
- Constructing figures from different gels, fields, exposures, and experimental series is discouraged. When this is necessary the component parts of composite images should be indicated by dividing lines clearly demarcated in the figure and described in the legend.