When feasible, put important points and conclusions in graphical form. Not everyone reads an entire article from beginning to end. When readers skim through an article, they are drawn to the figures. Try to make the figures and their captions

(1) tell the story.
(2) entice the reader to read the whole article.

**Highly recommended:**

If you’re not acquainted with Edward Tufte’s books, *Visual Explanations* should be required reading. He rules!


**Also highly recommended:**

“Graphing Resources” (http://www.ncsu.edu/labwrite/res/res-homepage.htm), particularly their “Revising your Visuals” section.
Figure captions are placed below the figure and aligned according to the journal’s style.

Figure 1. Field studies and microscopic experiments are being conducted to determine how plutonium is transported in groundwater. (a) Aerial view of the Nevada National Security Site; (b) transmission electron microscope image of Pu-contaminated groundwater. Colloids have been shown to play a significant role in transporting Pu at contaminated sites worldwide. [1]

Always begin the caption with the word “Figure” and the number assigned to that figure.

Think about how scientists “read” a journal article—they read the abstract, scan the “conclusions” section, and glance at the figures and tables.

Thus, figures must “stand alone”; a reader should be able to understand the main message in a figure without having to read the text.

This caption is insufficient. It should probably define the dDAC acronym (dynamic diamond-anvil cell), tell what the sample material is (liquid water being cooled under high pressure to below the freezing point), and specify both the pressure range and the elapsed time shown in the series of images. The black “spots” in each image should also be identified (ruby chips used to calibrate the pressure).


Ms. Particular quibble: the scale should be written as 45 μm. Units are always abbreviated when they are used with exact numbers that have been measured or calculated.
If a figure is taken from another source, it should be referenced in the caption.

Figure 3. Drawing of a dynamic diamond-anvil cell (dDAC). As diamond anvils compress micrometer-size samples, the piezoelectric actuator varies the static pressure, allowing researchers to examine how compression rates affect materials’ behavior. [1]

Written permission must be obtained from the publisher—not the author—to reprint a figure in another publication. We’ll talk more about this issue when we discuss copyrights later in the semester.

For purposes of this class, simply provide credit for figures you use.

If a figure is taken from another source, it should be referenced in the caption

Figure 3. Drawing of a dynamic diamond-anvil cell (dDAC). As diamond anvils compress micrometer-size samples, the piezoelectric actuator varies the static pressure, allowing researchers to examine how compression rates affect materials’ behavior. [1]
Make sure the labels are big enough to be read

These aren’t.
For talks, superimpose a new label

Insert a text box, no outline, and fill to match background
Make the arrows big enough to see, too

- anvil seats
- actuator
- static pressure screw
And always provide a scale

One of the most common mistakes authors make is not providing a reference scale for drawings and photographs. Always show a scale. While a reader might intuit that this device is pretty small, since it is used to compress mm-size samples, we have no way of knowing from the drawing whether the dDAC is 5-cm high or 30-cm high.
State what the figure is showing before launching into an explanation of what it means

Figure 3. The 1-D spherical target designs at NRL predict target gains of 100–300 for a few-MJ laser. This gain curve is an upper bound on possible target performance. A gain of at least 100 is required for fusion-reactor applications. (Courtesy U.S. Naval Research Laboratory)

Always give the “title” of the figure first. Tell the reader what she’s looking at before you start explaining the details.
Here’s the same figure and caption, but an explanation has been added to immediately orient the reader.

**Figure 5.** Plot of target gain as a function of input laser energy; the dotted line indicates the minimum gain required for fusion reactor applications. 1-D spherical target designs at NRL predict target gains of 100–300 for a few-MJ laser. This gain curve is an upper bound on possible target performance. (*Courtesy U.S. Naval Research Laboratory*)
Here’s another example—what’s wrong?

Figure 4. The in-phase output voltage amplitude of an RLC circuit shows a clear resonant response frequency at a peak around 980 Hz.

Here’s another example of an inadequate caption.
First, tell the reader what the figure represents.

Figure 4. Plot of the in-phase output voltage X vs. frequency. The in-phase output voltage amplitude of an RLC circuit shows a clear resonant response frequency at a peak around 980 Hz.
Describe all key elements in the figure

Avoid inset tables if possible; they’re usually too small to read.

Figure 4. Plot of the in-phase output voltage X vs. frequency. Filled squares represent measured points, and the red line is a fit to the data using a Lorentzian lineshape. The inset table gives the fit parameters associated with the Lorentzian fit. The in-phase output voltage amplitude of an RLC circuit shows a clear resonant response frequency at a peak around 980 Hz.

The caption must describe every element of the figure. The original caption is insufficient, because it doesn’t explain the significance of the filled squares on the plot and it doesn’t say what the table is for.
Use Arabic numerals and the word *figure* to denote figures and captions, e.g., Figure 1, Fig. 23

*Figure* should be capitalized when combined with a numeral to form the title of a specific figure

“Temperature variation is shown in Fig. 3.”

“The figure clearly shows the temperature variation with elapsed time.”

Don’t abbreviate *figure* (or anything else) if you use it to begin a sentence—or a caption.

You can use the “caption” feature in Word (and the equivalent utility in LaTeX) to assign consecutive numbers to your figures and to automatically update the numbers in the captions and the text if you move figures around, such that what used to be Fig. 8 is now Fig. 9.

The caption must begin with the number assigned to it in the narrative text.
When you submit “camera-ready” copy, you control where the figures are located in relation to the text and how multiple figures are presented.

When you submit a paper to a journal that still typesets manuscripts, you don’t. The compositor may decide that to save space and better fill up the page, he’s going to present your four photographs like this:

Now what’s “top” and what’s “bottom”?

Designate sub-figures using letters, in alphabetical order. Arrange them left to right, top to bottom (the way a reader reads English).
So that it can be copy edited, the caption should not be incorporated into the artwork.

Final 60 cm amplifier of the Nd:KLiF laser

(Image courtesy U.S. Naval Research Laboratory)

Put figure captions (including the figure number) in separate text, not embedded into graphical files.
Don Ranly’s Rules for Captions*

Every picture needs a caption.

Captions are read five times more than the text.

Complement the image; say what it does not say.

Give useful information.

Connect the figures to the text. A good caption says “see story” without saying it.

Write complete sentences.

Use active verbs in the present tense.

The plot shows that a phase transition occurs at 77 K.
A phase transition was observed at 77 K, as shown.

Scale the caption to the size of the image; captions should be at least two lines, optimum three lines, maximum four lines.

*http://www.ranly.com


Don Ranly is professor emeritus of the Missouri School of Journalism.
http://www.ranly.com

His remarks were intended for newspaper reporters and editors, but they’re good advice for scientists, too.

Ms P quibbles:

I would rewrite Professor Ranly’s Rule #1 to “Every picture MUST HAVE a caption,” but that’s a rant for another day. (Refer to Ms. Particular on “need.”)

I would also say that the passive-voice construction is just fine, too but I have enough trouble convincing physicists of the superiority of the passive voice for science writing. I’m not about to take on journalists. (Never argue with someone who buys ink by the barrel and paper by the ton.)
To recap:
Place the caption below the figure
Number figures consecutively and call them out in the text before displaying them
Identify what is being shown at the beginning of the caption
Describe all elements of the figure in the caption
Make labels big enough to be legible
Always provide a scale

NOTES: