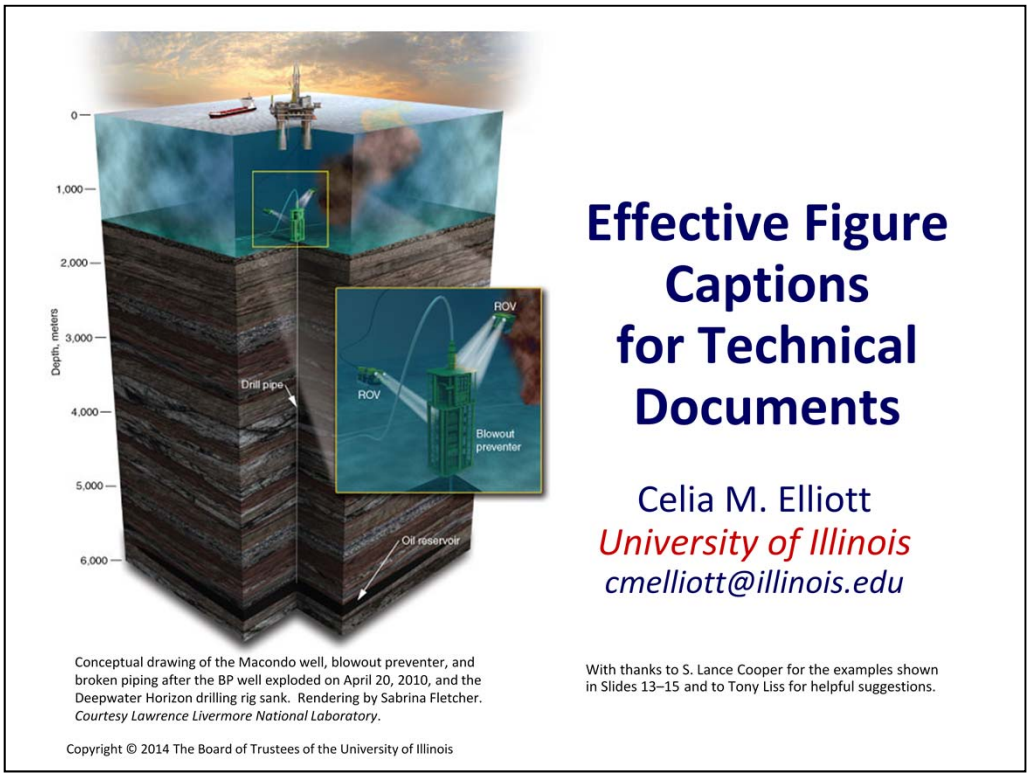
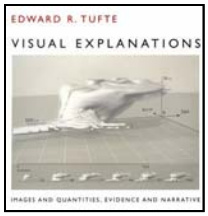


When feasible, put important points and conclusions in graphical form. Not everyone reads an entire article from beginning to end. When readers skim through an article, they are drawn to the figures. Try to make the figures and their captions

(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!



Edward R. Tufte, *Visual Explanations: Images and Quantities, Evidence and Narrative* (Cheshire, CT, Graphics Press, 1997).

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

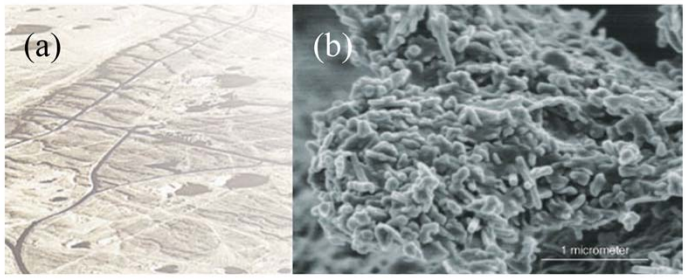


Figure 1. (a) Aerial view of the Nevada National Security Site; (b) transmission electron microscope image of Pu-contaminated groundwater. Colloids have been shown to play a significant role in transporting Pu at contaminated sites worldwide. [1]

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

1. A. Heller, "Plutonium Hitches a Ride on Subsurface Particles," Science & Technology Review, October/November 2011, https://str.llnl.gov/OctNov11/kersting.html.

Describe all elements of the figure without referring to material in the text

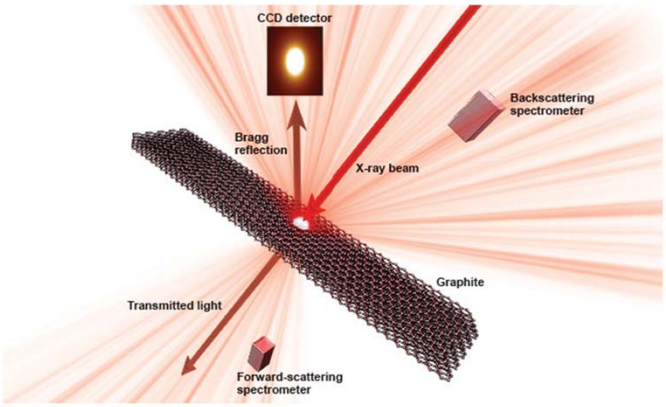


Figure 2. Experimental setup to measure breakdown of solid-crystal graphite. A charge-coupled device (CCD) detector simultaneously collects Bragg-reflected x-ray laser light as crystal x-ray spectrometers collect light from inelastically scattered photons, enabling observation of extremely fast changes in graphite "melting." [1]

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

1. "Graphite, a Quick-Change Artist," *Science & Technology Review*, Jan-Feb 2014, Lawrence Livermore National Laboratory. Published online at https://str.llnl.gov/january-2014/hau-riege.

What's wrong with this caption?

Figure 4. An image sequence from a dDAC experiment shows the growth of a dendritic ice-VI crystal in response to increasing compression. [1]

- **dDAC not defined (caption must "stand alone")**
- **sample material not specified**
- **pressure range and the elapsed time not specified**
- **black "spots" in each image not identified**
- **label pointing out the "crystal" would be helpful**
- **"micrometers" should be "μm"**

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).

1. Kristen Light, "Diamonds Put the Pressure on Materials," Science & Technology Review, June 2010, Lawrence Livermore National Laboratory. Published online at https://str.llnl.gov/June10/evans.html.

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

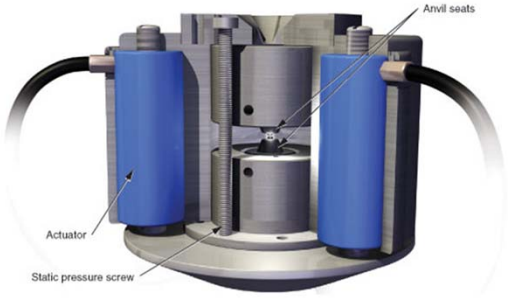


Figure 3. Drawing of a dynamic diamond-anvil cell (dDAC). As diamond anvils compress micrometer-size samples, the piezoelectric actuator varies the static pressure, allowing researchers to examine how compression rates affect materials' behavior. [1]

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.

1. Kristen Light, "Diamonds Put the Pressure on Materials," *Science & Technology Review*, June 2010, Lawrence Livermore National Laboratory. Published online at https://str.llnl.gov/June10/evans.html.

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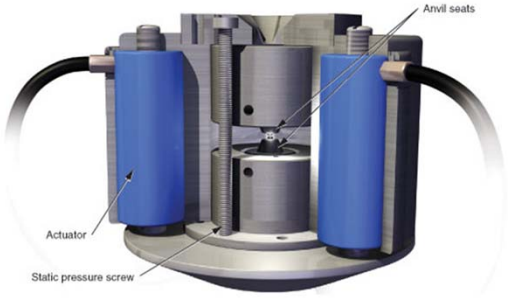

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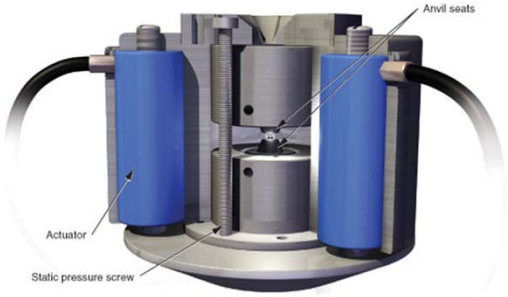
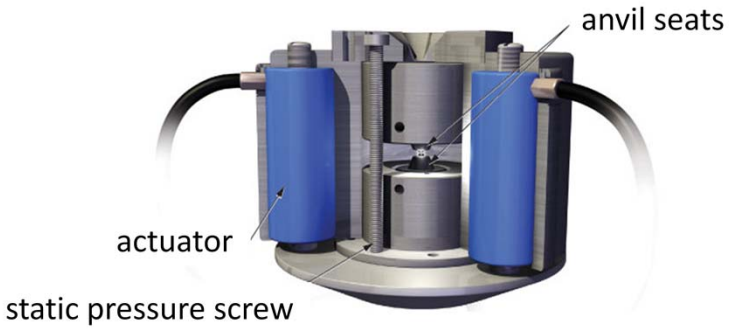
Make sure the labels are big enough to be read



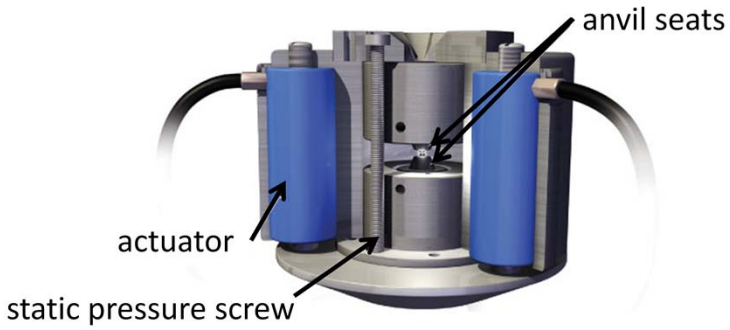
These aren't.

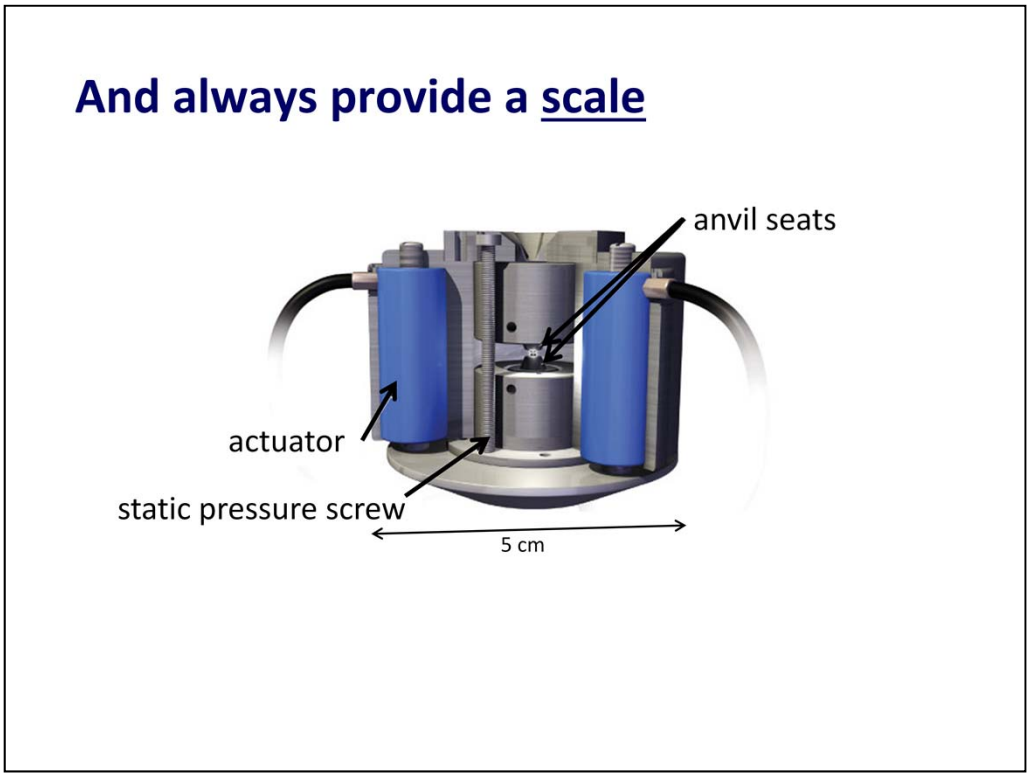
For talks, superimpose a new label



Insert a text box, no outline, fill to match background

Make the arrows big enough to see, too





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 20-cm high.

State what the figure is showing before launching into an explanation of what it means

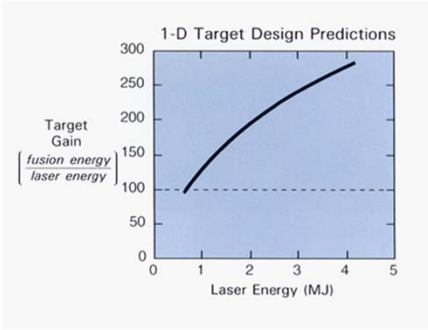


Figure 3. The 1-D spherical target designs at NRL predict target gains of 100–300 for a few-MJ laser. This gain curve is an upper bound on possible target performance. A gain of at least 100 is required for fusion-reactor applications. (*Courtesy U.S. Naval Research Laboratory*)

Always give the "title" of the figure first. Tell the reader what he's looking at before you start explaining the details.

State what the figure is showing before launching into an explanation of what it means

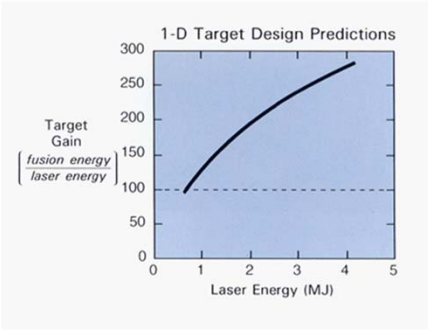


Figure 3. ***Plot of target gain as a function of input laser energy; the dotted line indicates the minimum gain required for fusion reactor applications.*** The 1-D spherical target designs at NRL predict target gains of 100–300 for a few-MJ laser. This gain curve is an upper bound on possible target performance. (*Courtesy U.S. Naval Research Laboratory*)

Always give the "title" of the figure first. Tell the reader what he's looking at before you start explaining the details.

Here's another example

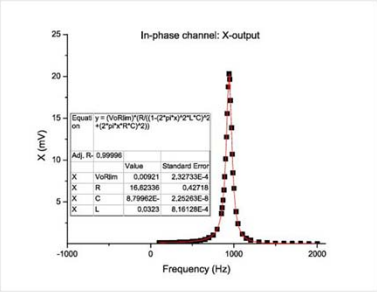


Figure 4. The in-phase output voltage amplitude of an RLC circuit shows a clear resonant response frequency at a peak around 980 Hz.

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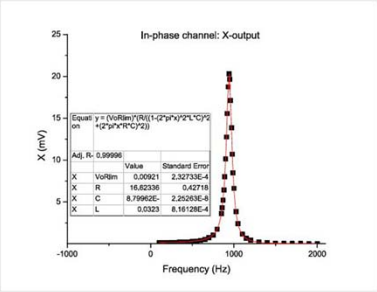


Figure 4. ***Plot of the in-phase output voltage X vs. frequency.*** **The in-phase output voltage amplitude of an RLC circuit shows a clear resonant response frequency at a peak around 980 Hz.**

First, tell the reader what the figure represents.

Describe all key elements in the figure

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

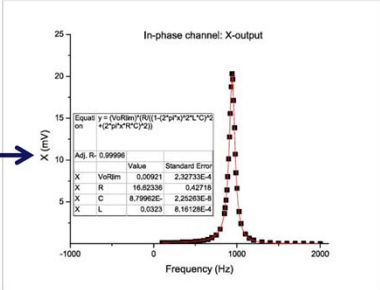


Figure 4. *Plot of the in-phase output voltage X vs. frequency.* ***Filled squares represent measured points, and the red line is a fit to the data using a Lorentzian lineshape. The inset table gives the fit parameters associated with the Lorentzian fit.*** **The in-phase output voltage amplitude of 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.

Number figures consecutively and "call them out" in the text

Microphotographic images of pressure-induced dendritic crystals (top row) are remarkably similar to the patterns produced in computer simulations of temperature-driven dendritic crystal growth (bottom row). [1]

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.

1. Kristen Light, "Diamonds Put the Pressure on Materials," Science & Technology Review, June 2010, Lawrence Livermore National Laboratory. Published online at https://str.llnl.gov/June10/evans.html.

Number figures consecutively and "call them out" in the text

Figure 6. Microphotographic images of pressure-induced dendritic crystals (top row) are remarkably similar to the patterns produced in computer simulations of temperature-driven dendritic crystal growth (bottom row). [1] *(Courtesy Lawrence Livermore National Laboratory)*

Identify parts of a figure by letters or numbers, not spatial descriptions

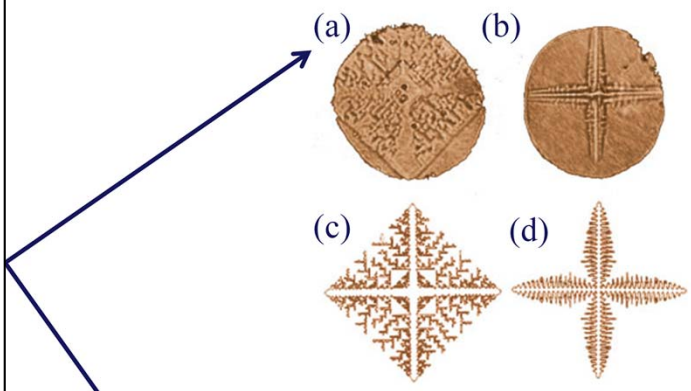


Figure 6. Microphotographic images of pressure-induced dendritic crystals **(a, b)** are remarkably similar to the patterns produced in computer simulations of temperature-driven dendritic crystal growth **(c, d)**. [1]
(Courtesy Lawrence Livermore National Laboratory)

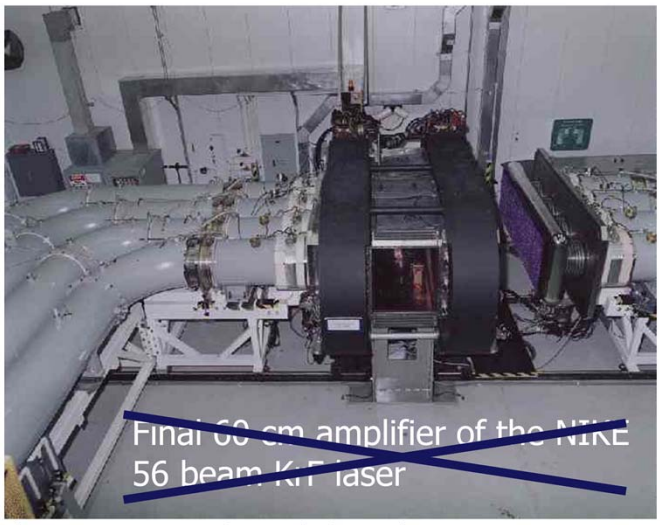
When you submit "camera-ready" copy, you control where the figures are located in relation to the text and how multiple figures are presented.

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



(*Image courtesy U.S. Naval Research Laboratory*)

Put figure captions (including the figure number) in separate text, not embedded into graphical files.

Don Ranly, "Ranly on *Heads*," University Research Magazine Association Annual Conference, Florida State University, May 16–19, 2006.

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.

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.")