Graphic Design for Scientists

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Outline

- Will be discussing several important factors for scientific graphic design, including:
  - Image file formats.
  - Tools to use.
  - Layout.
  - Fonts.
  - Color.
- With this info, you should be able to design high-quality posters and papers, for inclusion in any conference.

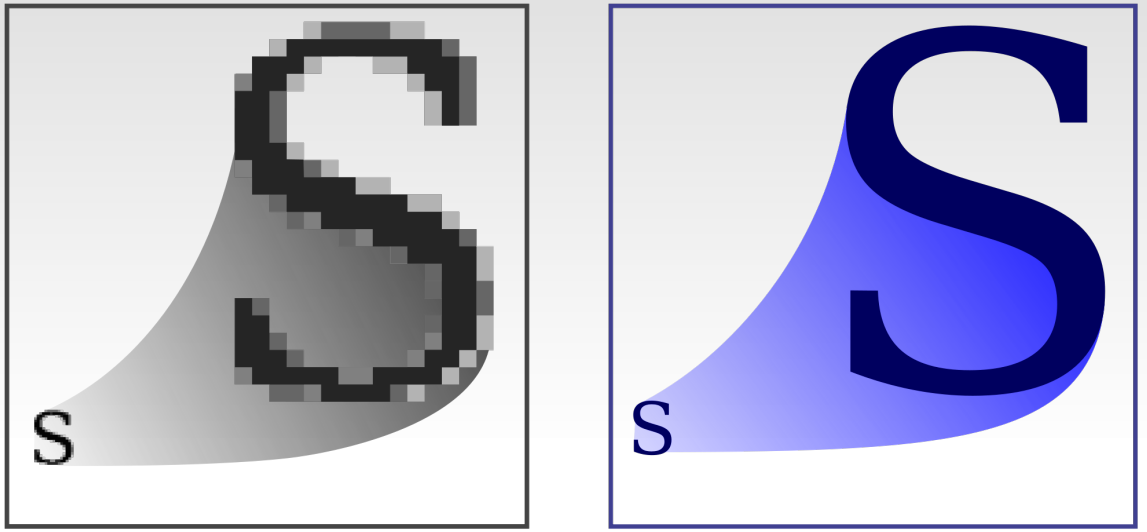
Credentials

- What gives me the background necessary to talk on this subject?
  - Not much.
  - You may come to different conclusions than me.
- Any of you can learn how to put together a high-quality poster or paper.
  - Learn a few simple rules.
  - See what other people are doing (and steal it).
  - Remember that quality artwork takes time.

Image File Formats

- **#1 graphical mistake in scientific publications!**
- Some vocabulary:
  - Lossy – image is compressed in some way that only approximates the original image.
  - Transparency – elements are either visible or invisible.
  - Translucency – elements may be semi-transparent.
  - Artifact – defects resulting from a storage method, such as from a lossy image or a magnified raster image.
  - Antialiasing – adding intermediate pixels to avoid pixelated appearance.

Raster vs. Vector Graphics

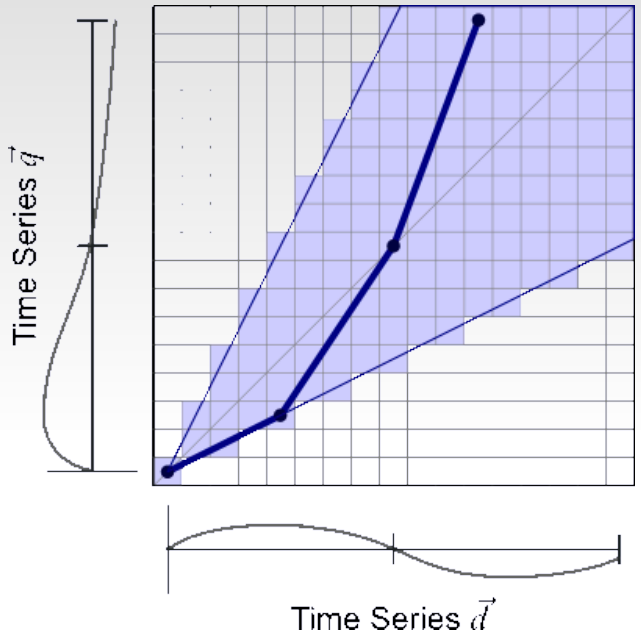


Raster
.jpeg .gif .png

Vector
.svg

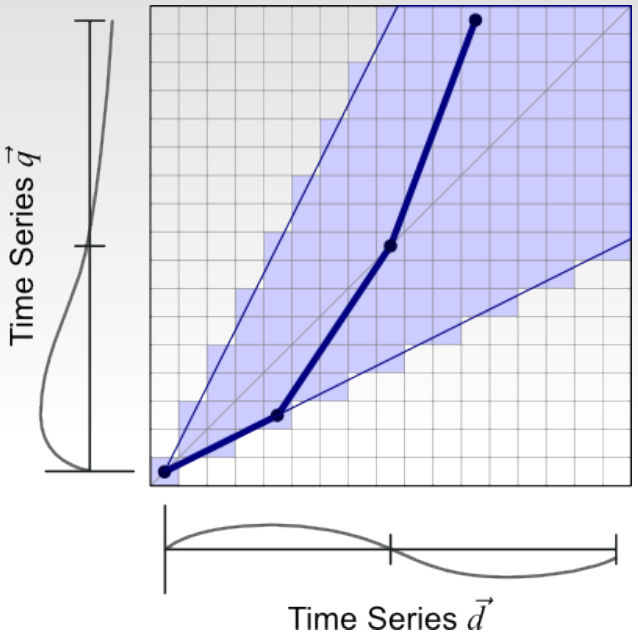
- Raster image – primitives are *pixels*.
  - "Pixelates" when magnified.
- Vector image – primitives are *lines, points, curves, circles, rectangles, etc.*

GIF: Graphics Interchange Format



- Raster/nonlossy.
- Limited to 256 colors.
- Can be animated.
- Transparency, but no translucency.
- Outdated.

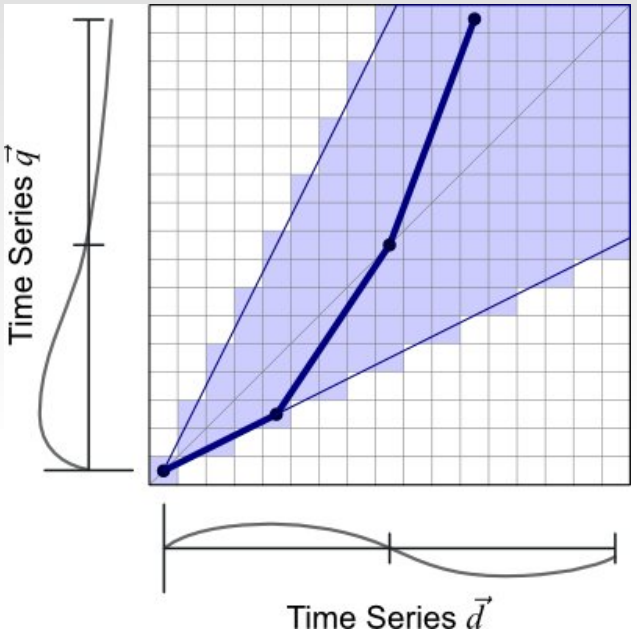
PNG: Portable Network Graphics



- Raster/nonlossy.
- No color limitation.
- Full translucency.

- Can be inefficient.
- Use when JPEG/SVG won't work.

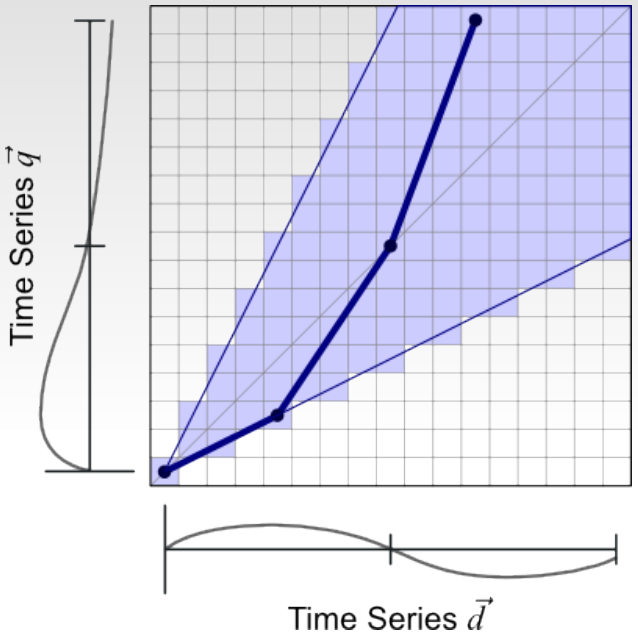
JPEG: Joint Photograph Experts Group



- Raster/lossy.
- Made for photos & other natural images.
- Efficient.

- No transparency or translucency.
- Shows artifacting for nonnatural images.

SVG: Scalable Vector Graphics



- Vector/nonlossy.
- Wonderful for graphs/word art/logos.

- Full translucency.
- Doesn’t pixelate.
- Can’t accurately represent photos.

Some Other Formats

- PDF (Portable Document Format): can be used to hold either vector or raster graphics, good format for exchanging.
- PS/EPS ((Encapsulated) PostScript): predecessor to PDF. Often used for vector graphics.
- TIFF (Tagged Image File Format): not really a file format, but more a wrapper for several formats.
- JPEG 2000: updated version of JPEG, capable of storing some nonlossy data. Rare.

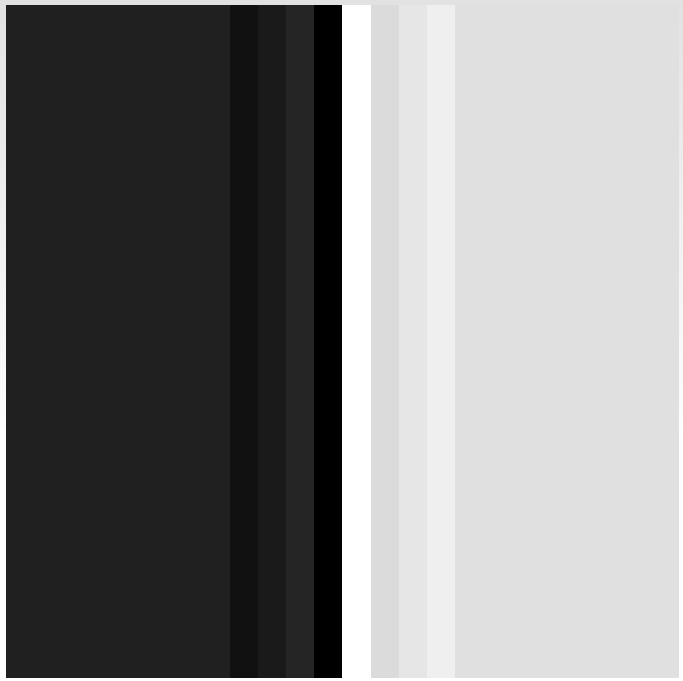
Some Other Formats

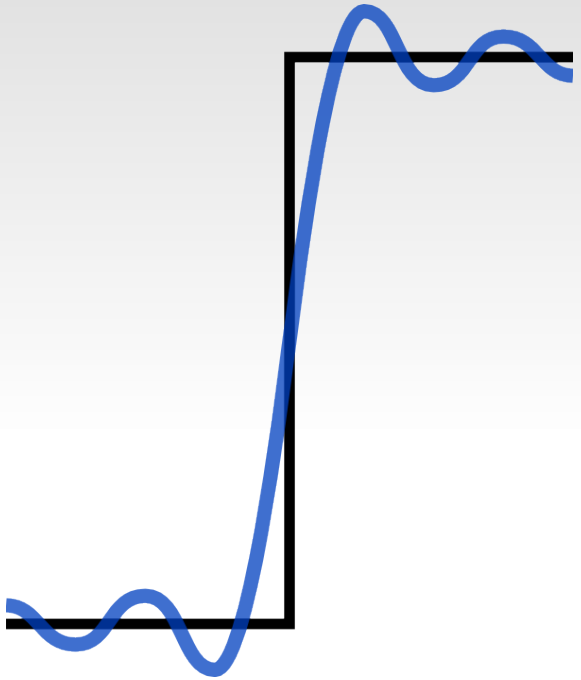
- BMP (BitMaP): raster format used mainly by Windows. Avoid.
- AI (Adobe Illustrator): proprietary vector format for Illustrator.
- PSD (PhotoShop Document): proprietary vector format for Photoshop.
- XCF (eXperimental Computing Facility): native GIMP format.

JPEG Closeup Reveals Artifacts

- Sometimes things you get away with on a screen, don't work on paper.
- JPEGs can look particularly bad when printed out.

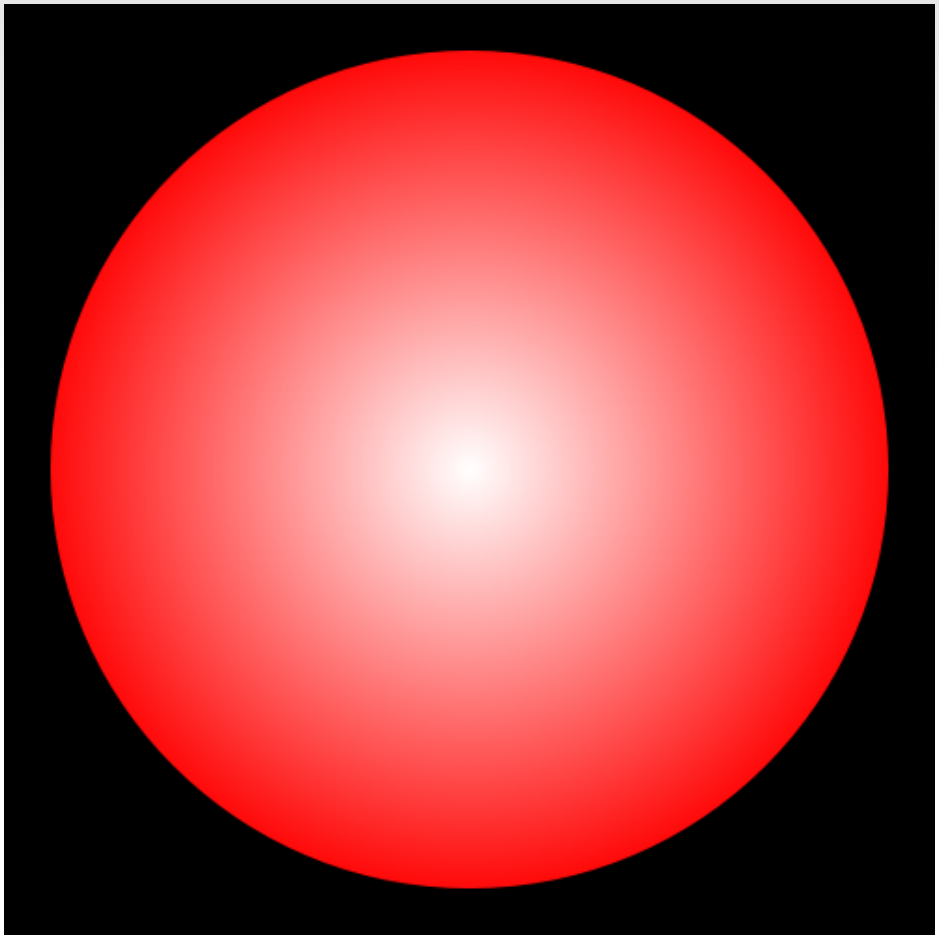
The JPEG Algorithm...

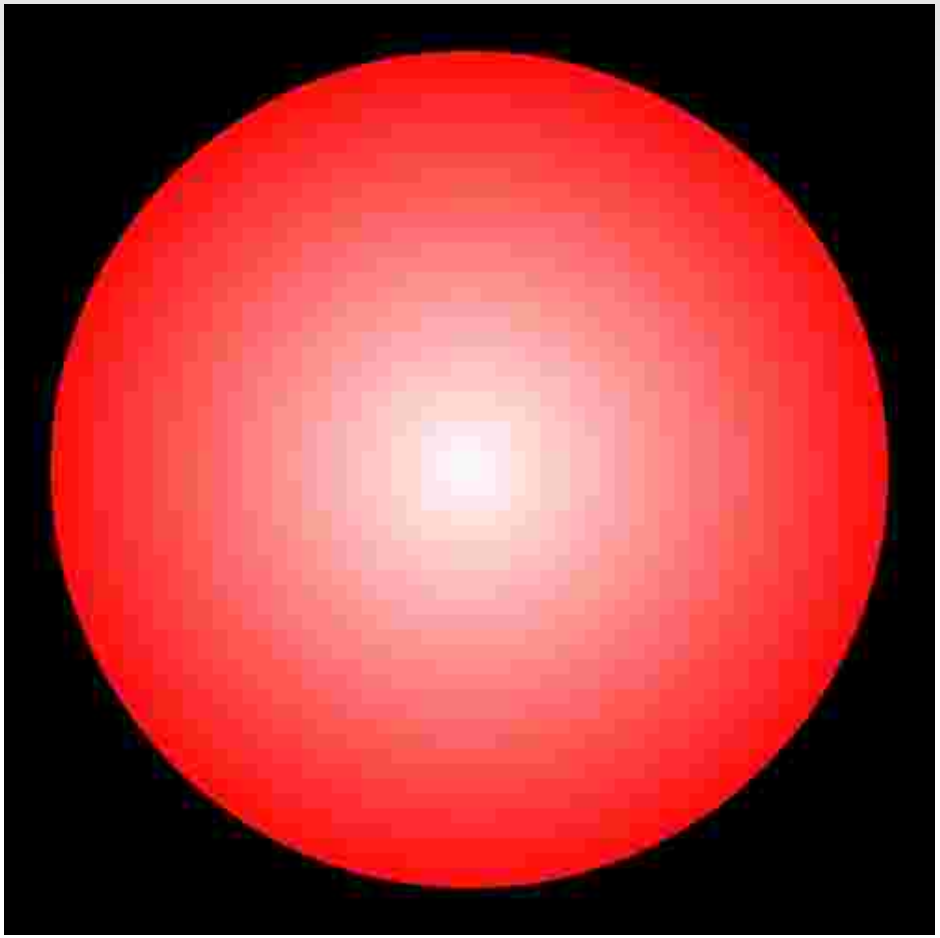




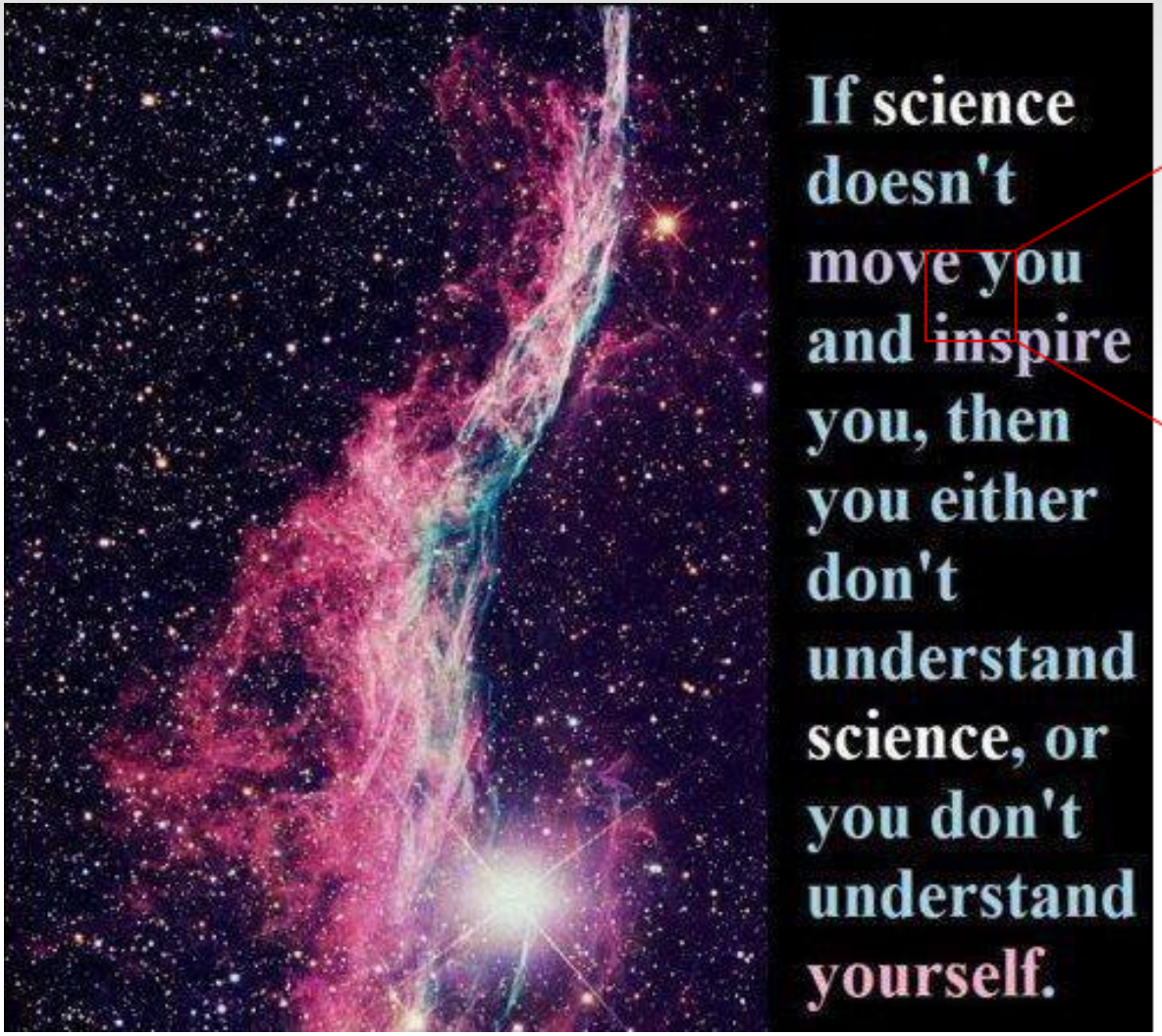
- Split image into 8×8 tiles.
- Do Fourier transform to pick out component sines.
- Throw away least significant waves.

...results in this...





...or this:


If science doesn't move you and inspire you, then you either don't understand science, or you don't understand yourself.

Degrading Qualities of JPEG

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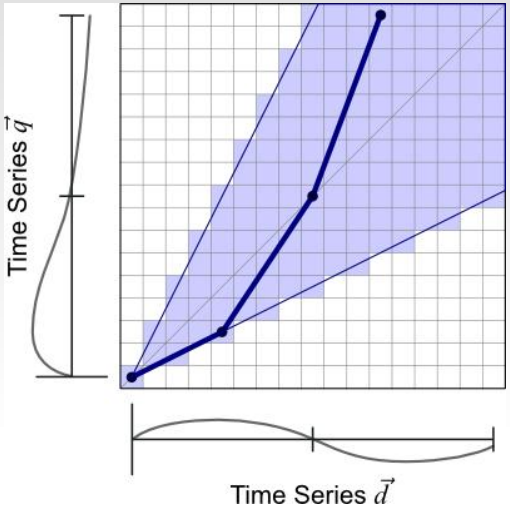
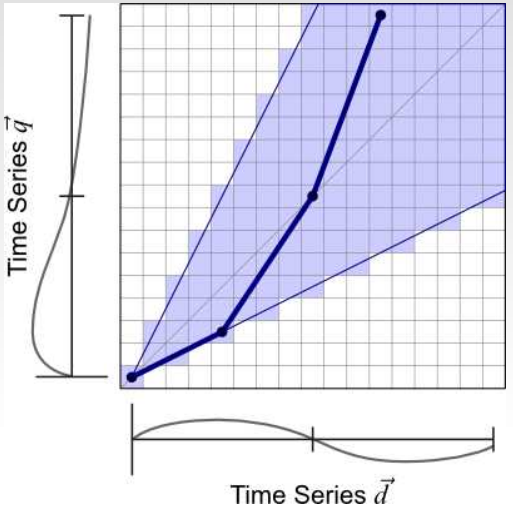
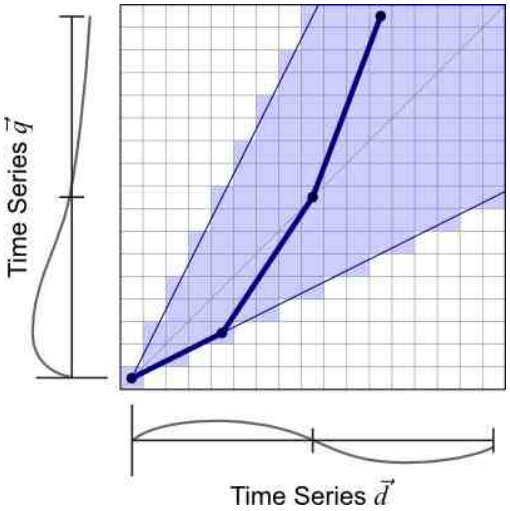
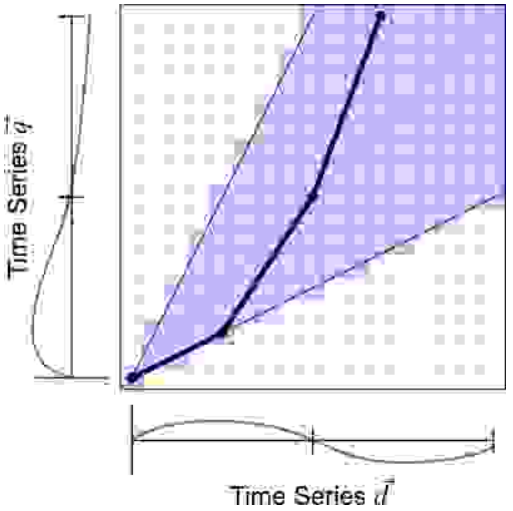








Which Tools to Use?

- If you're using PowerPoint, you're doing it wrong.
  - Made for presentations, not posters or drawing.
  - Adding a ton of (unnecessary) work.
  - Difficult to get high-quality results.
- So what do we use instead?
  - Raster-image editing program (e.g. Photoshop).
  - Vector-image editing program (e.g. Illustrator).
  - Office suite (e.g. Office).
  - Possibly a typesetting program (e.g. LaTeX).
- Easy to spend thousands of dollars.

The Good News

- There are free competitors to all these programs.
  - Instead of Photoshop, use the **GIMP**.
    - *Gnu Image Manipulation Program*
  - Instead of Illustrator, use **Inkscape**.
    - *Highly recommended.*
  - Instead of Office, use **LibreOffice**.
- All of these are 100% free, legal to download, and even to modify!
- Versions for Windows, Macintosh, and Linux.

Creating Photographs

1) Take photo with a digital camera, upload.
2) Resize using the GIMP/Photoshop.
3) Possibly adjust colors, brightness/contrast.
    - Scientific honesty will prevent you from too much manipulation.
    - Remember, journals will check for signs of manipulated photographs.
4) Save as a high-quality JPEG.

Creating Graphs & Charts

1) If numerical data, use a spreadsheet program to create the original image.
    - Save/print as PDF or SVG.
2) Load in Inkscape to customize.
    - Alter fonts and lines to taste.
    - Remove background.
3) Save as SVG/SVGZ.
4) Output as PNG if needed.

Creating a Poster

1) Use Inkscape to make the overall poster.
   - Create each figure separately, saved in its own file. (Useful for papers.)
   - Import them in, place as wanted.
2) Save as SVG/SVGZ.
3) Save a copy as PDF, use to print final product.
   - Be sure to “convert texts to paths.”
   - PDFs can also be printed on standard 8½"×11" paper.

Fonts

- Good fonts cost money.
  - Each glyph must be created by hand.
  - High-quality fonts include glyphs for obscure elements (bold, italic superscript H).
  - Odds are, you won't have access to these.
- How can we make due with Times New Roman, Arial, etc?

Serif vs. Sans-Serif

- A serif font has small crosses at its points.
  - Example: Times New Roman.
  - Serif fonts are easier to read, and should be used in copy.
- A sans-serif font does not have these crosses.
  - Example: Arial.
  - Sans-serif fonts appear bolder and more dynamic, and can be used to effect in titles and figures.
- *Never* assume that someone else has the same fonts that you do.

Symbols

- Fortunately, many standard fonts include many symbols.
- Be sure to use the proper ones:
  - “ vs. ” vs. ", ` vs. ′ vs. ‘ vs. ’ vs. '
  - - vs. − vs. – vs. —
  - x vs. ×
- Inkscape can print them out if you know the Unicode code for them.
  - × is Ctrl-U D7 <enter>
  - Note that Unicode uses base 16 (hexadecimal).

Superscripts & Subscripts

H_2SO_4 H_2SO_4 H_2SO_4

Right way. Wrong way. Good-enough way.

- A good font will include special subscript glyphs.
- Subscripting by shrinking full-size glyphs leads to weighting problems.
- Can be countered by bolding the subscripts.

Small Caps

HELLO! HELLO! HELLO!

Right way. Wrong way. Good-enough way.

- Same things applies to using small caps–good fonts have independent glyphs.
- The weight in the middle example (with simulated small caps) is clearly off.
- Use bold to mitigate the damage.

Color

- Color can be difficult.
- Color in computer art is defined by RGB:
  - One byte (0-255) each of red, green, and blue.
- Try to avoid extremes.
  - Don't use many strong, clashing rainbow shades.
  - Avoid true black and true white.
- Remember background.
  - The same color will appear different against different backgrounds.

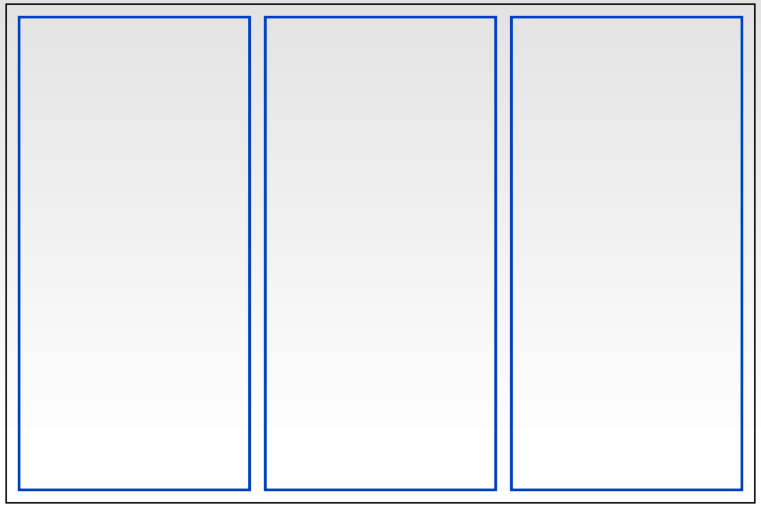
Color Concerns

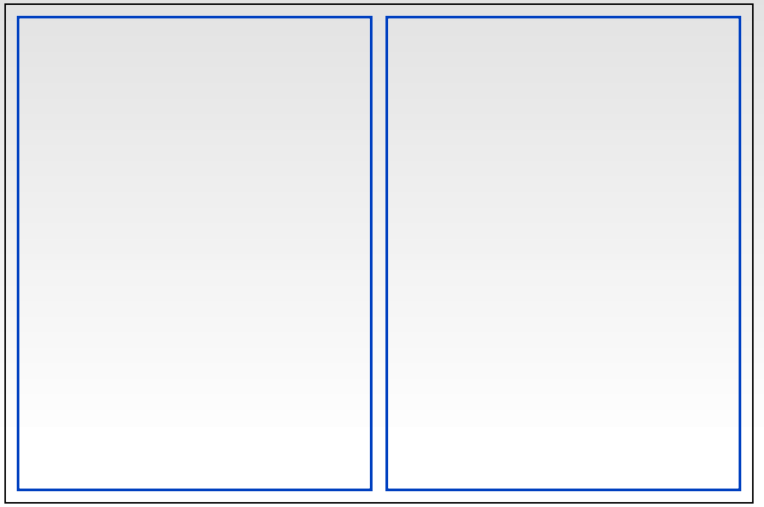
- About 8% of men and 0.5% of women are color-blind.
  - Most common: **red**-**green**.
- More important–many people will see your paper printed in black & white.
  - Try to make color an additional benefit, but not necessary for understanding.

Color Resources

- http://www.colourlovers.com/
  - People post color combinations, and vote on them.
  - All these combinations are shown, giving you a chance to decide what you like best.
- http://jfly.iam.u-tokyo.ac.jp/color/
  - How to make a document that is color-blind safe.
- http://www.perceptualedge.com/articles/visual_business_intelligence/rules_for_using_color.pdf
  - Good rundown on use of color.

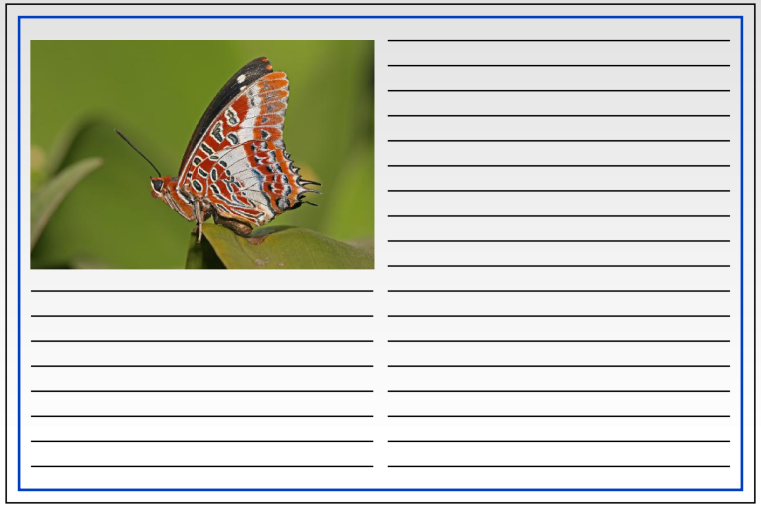
Some Last Design Tips

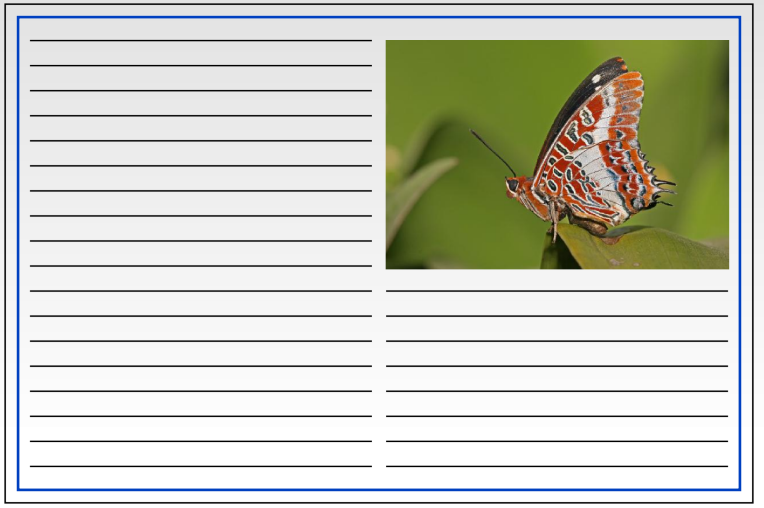




- Try to maintain an odd number of “regions” of your poster.
  - Doing so will keep your document appearing more “dynamic.”

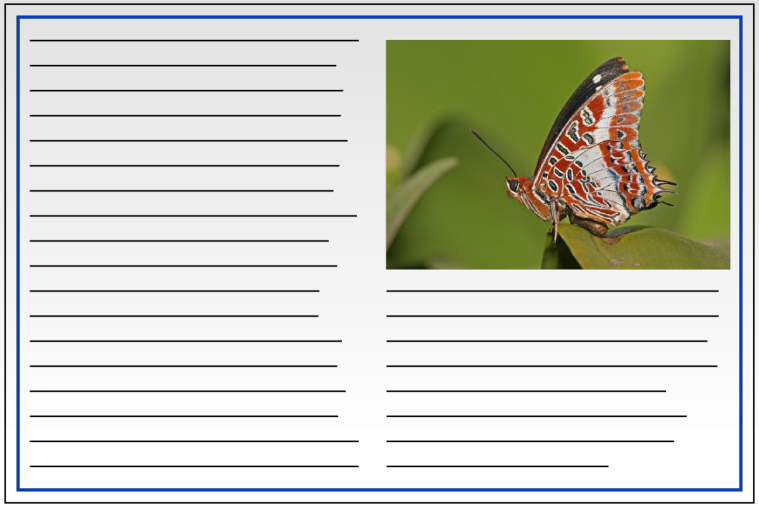
Some Last Design Tips





- Position “directed” images facing inward.
  - Human instinct is to look where the subject is looking.
  - Make sure that's more of the document, not something outside.

Some Last Design Tips



- Try to avoid “trapped whitespace”.
  - Attracts the eye to negative space.
  - Use consistent, strong boundary lines.

Some Last Design Tips

- Tons and tons of practice!
- Communicating scientific ideas well is not easy!
- Explore on your own, discover what works and what doesn't.

Last Resources

- “Method of Action” – http://method.ac/
  - Design for programmers.
  - Quizzes and games to teach design principles.
- Edward Tufte – http://www.edwardtufte.com/
  - Professor emeritus at Yale.
  - Written books on visual communication of information.

You're Cursed!

IF YOU REALLY HATE SOMEONE, TEACH THEM TO RECOGNIZE BAD KERNING.

Thank You

- Thanks to Wikipedia, Wikimedia Commons, and XKCD for graphics.
- Any questions?