Using Images to Enliven Scientific Articles

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This editorial considers the use of images as a way to enhance the readability and possibly the impact of scientific writing. Readers are asked to envision effective scientific writing as a form of storytelling. Some stories can be enhanced by adding a diagram or a step-by-step procedure. Inherently dull results might be enlivened (in a cautious manner) with a non-typical graphical portrayal. A potentially tedious theoretical point might be lightened with a touch of humor, which might seem out of place if it were expressed in text. Keep these options in mind as you are creating your next story, *i.e.*, your next research article.

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Using Images to Help Explain Things

A picture can be worth a thousand words. By adding images to your scientific article, you have the opportunity to focus the reader's attention and to convey a certain way of visualizing the information contained in the article. For instance, images can be particularly effective when they are used to show the basic steps in a procedure, as in the following example (Fig. 1).

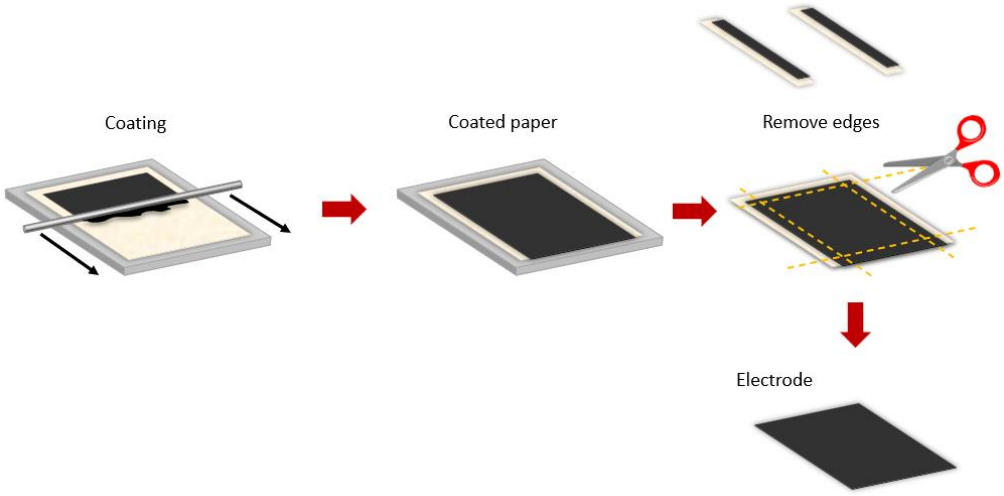

Fig. 1. Steps in laboratory preparation of samples of coated paper

By using such a diagram, the reader needs less time to grasp the main steps of a procedure. Imagine how many words would have been needed to describe all of those steps! But some attention to details is essential. Notice the labels in the figure. The figure

needs to be sufficiently clear that "one thousand words" are not needed in the text to further clarify what has been shown.

Using Images to Show Results

When presenting numerical results from a scientific study, it is easy to assume that there is just one way to present data. But in most cases there are choices to be made. For instance, in Fig. 2, an innovative scheme was employed to show four different numerical values on the same 3D (but actually 2D) graph. By conveying the information in a unique way, there may be opportunities to help the reader to gain quicker or more complete insights into the meaning of the research being presented. There can be challenges too. As shown at right, basis weight is depicted by the size of the ball points. However, you can see that the biggest one should be the red one. The reason why the red one in the plot is not the biggest is because of the 3D perspective, the red ball is behind the blue-green ball. The different colors were used to distinguish from the paper substrate. Therefore, this image is providing: roughness, water contact angle of the paper substrate, effective residual ink concentration (ERIC), basis weight, and color to recognize which ball represents which paper substrate. But the size of the balls must be misleading because of the perspective that comes with 3D.

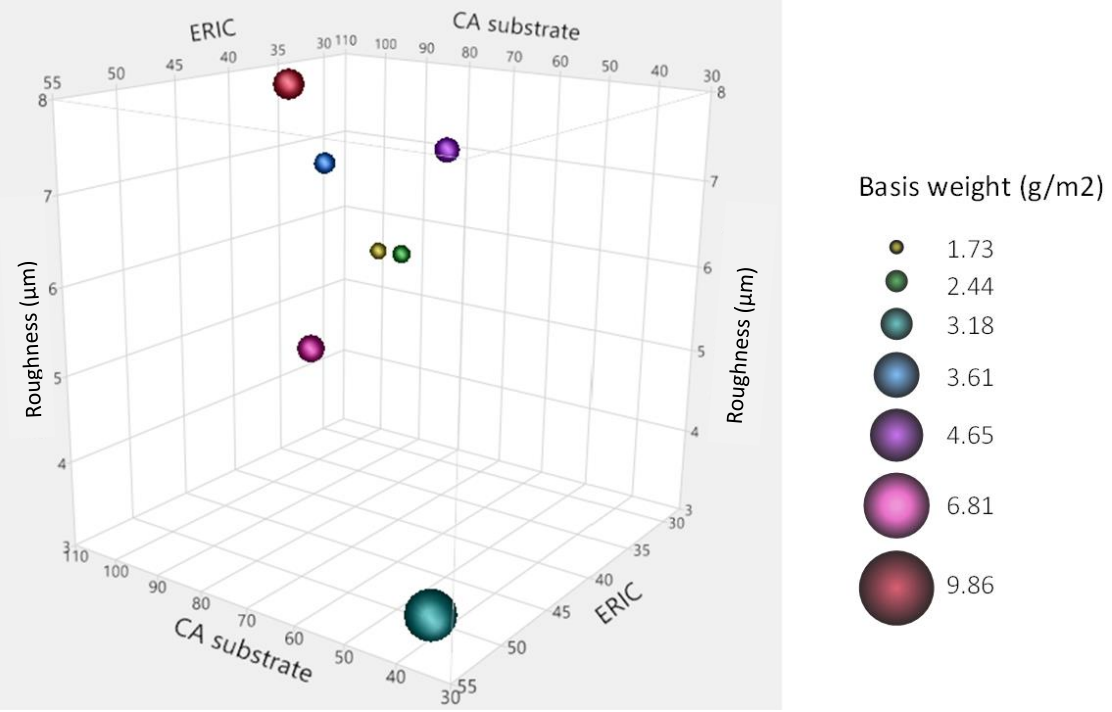

Fig. 2. Example of a four-dimensional plot portrayed as a 2D view. Here ERIC corresponds to the effective residual ink concentration, and CA corresponds to contact angle.

Using Images to Lighten Up Your Article

Humor can be an effective contribution to communication, especially in verbal conversations and presentations. But what about in scientific writing? Whereas the scientific writing itself might not be regarded as an appropriate venue for humor, the rules are often less clear when it comes to the graphic images. For instance, the following image

could be used to convey the idea that a function having too many terms is not desirable. One could say that you could fit anything, even an elephant, with such a function!

Notice in this hypothetical plotting of a mathematical fit to an elephant that the predicted amplitude can be expected to vary in a wildly erratic manner when outside the range of *x* values that were considered. The wild gyrations of the predictions, just outside of the actual data, ought to make both researchers and readers suspicious regarding the usefulness of such a mathematical model.

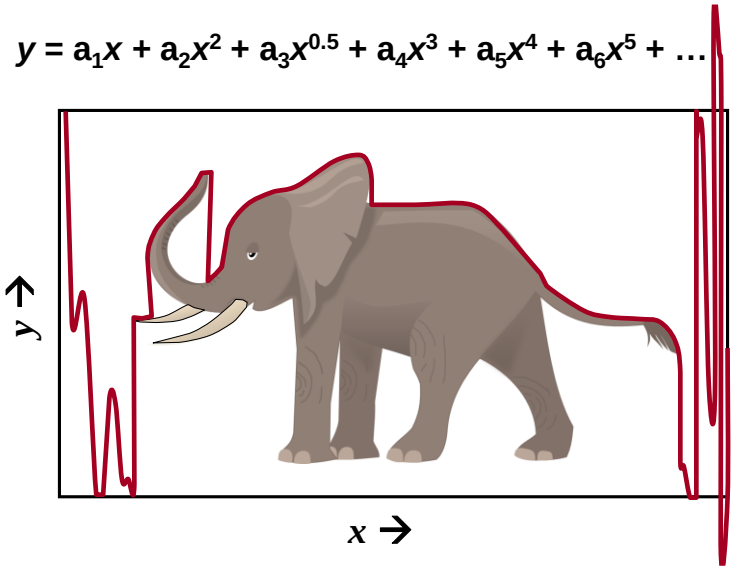

Fig. 3. Hypothetical fitting of a function with many terms "to an elephant"

Fortunately there is a statistical parameter that researchers can use to help judge whether a mathematical model contains too many terms. That parameter is the adjusted R^2 value. The rule is to not add an additional term to a mathematical model if such addition makes the adjusted R^2 value decline in value.

Images Should Add, Not Dominate

Think back to some of the most effective talks you have ever heard. Maybe a talk you heard in a house of worship caused you to find new meaning in your life. Maybe a scout leader did the same, by means of an intriguing story they told. Chances are that no images were shown. Maybe the only images were those that occurred in your own mind during such a talk. In light of such lessons, it makes sense not to overwhelm your audience with too many images. Many publishers of scientific articles place a limit on the number of figures. But many of them provide the option of an appendix or a "supplementary materials" section, just in case there might be some readers who are especially interested in certain graphics that most readers will ignore.

In summary, we envision scientific writing as telling a story. Just like in a good storybook, some good visuals can help set the mood and help the story along. Also, if the image made an impact, then it is more likely a reader will remember the point being made.