

Like last week, there are two topics in this week's Photon Snacks: preliminary results from the survey about future topics for this column In Light Bytes and typesetting equations in reports, theses, dissertations, refereed papers, proceedings, and any other scientific writing.

Preliminary Survey Results

Last week I let you know about a survey that I was conducting about future topics that can grace the Photon Snacks' column. This survey is located in Google Forms at: <https://forms.glehttps://forms.gle/ibC9LhPemeniJwhv9/ibC9LhPemeniJwhv9>, and there were three questions:

- Give your preferences for topics in the Photon Snacks' column of Light Bytes,
- Suggested columns in the above or any other topic areas, and
- Suggested individuals (and topics) who could write a column - including you!

I had a "stellar" reply! Two of you did the survey, but note that I will keep this survey open "forever" so that if you want to provide your opinion, your opinion changes over time, or you have suggestions for authors and/or topics, you can submit them. I plan to continue Photon Snacks on a weekly basis when classes are in session in the Fall and Spring semesters, so all of your input is greatly appreciated. What were the results of this two-samples received survey? Well, a nice chart is shown in Fig. 1 for the first question.

Give your preferences for topics in the Photon Snacks' column of Light Bytes

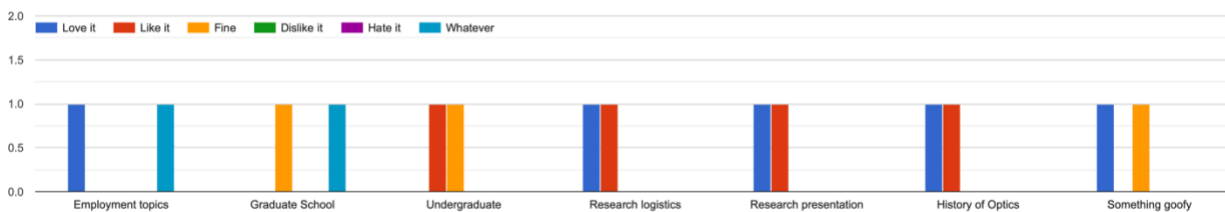


Figure 1. Results from the Photon Snacks' survey about the topics that interest you the most.

Three topics had the top rating, so far: research logistics, research presentation, and history of optics. Here are where the previous three columns lie per the topic areas shown in Fig. 1:

- Working in a Research Lab (Photon Snacks 3): Research Logistics,
- Graduate School (Photon Snacks 2): Graduate School, and
- Animal Optics (Photon Snacks 1): Research Presentation.

Additionally, the second part of this column on typesetting equations will also be in the area of Research Logistics. The topics receiving the lowest votes, in order of lowest to highest, are Graduate School, Employment Topics, Undergraduate, and Something Goofy. There were no suggestions for columns, writers, or the like. This week, I will stay with the Research Logistics

area. If you do the survey, I will have more data about your interests. So, please go to: <https://forms.gle/ibC9LhPemeniJwhv9>.

Typesetting Equations

Have you ever looked at a journal or proceeding paper and wondered what are the standard criteria for the typesetting or formatting of the equations printed therein? Yes, there are standards that you are supposed to follow, and each journal or proceeding may have different ones. The standards in my opinion are:

- The variables/parameters are written in the prescribed size and font (i.e., the same size and same font as the text in the body of the manuscript), but:
 - Typeset in *italics* if it denotes a single value and uses standard English letters that are either uppercase or lowercase and lowercase Greek letters or
 - Typeset in plain/standard/normal text if uppercase Greek letters, except
 - When the variable is a vector or matrix it will be typeset in **bold** and
 - In the body of the text you will follow the same styling rules;
- Most other items will be typeset in plain/standard normal text, including:
 - Function calls such as cos, sin, sinh, and erf;
 - Numbers and mathematical symbols; and
 - Units and the like;
- Most equations will be written on their own line with an equation number. To layout the equation on the page:
 - Place a “center-justified” tab in the center of the margins. This tab will center the text in the center of the page and
 - Place a “right-justified” tab at the right edge of the margins. This tab will place the equation number at the edge of the right hand margin; and
 - The equation number will be written with the number in parentheses, such as: (3);
- Transitioning from the text body to the equation is done by the following steps:
 - The equation is part of the sentence, so the sentence beforehand does not need any punctuation unless required per the presentation,
 - Punctuation may be required at the end of the equation, dependent on the presentation,
 - Follow the journal rules for white space around the equation. It is typical to provide white space to offset the equation a little, and
 - You **MUST** define each of the parameters in the equation, such as within the text after an equation you may write something like, “where r is the radius of the optic, n is its index of refraction, and V is the material’s Abbe V-number.”

Note that each journal can have different rules which may also evolve over time, but the above is the standard I have seen as of late for most STEM-related journals, including optics ones. When you direct the reader to an equation from a different point in the text body, you will say something akin to, “Substituting Eq. (1) into Eq. (3), you obtain...”. See Fig. 2 for an example that I concocted for a discussion of display screen sizes.

The size of a television screen is measured by its diagonal distance, which is found by using the horizontal and vertical sizes of the display area. To find this diagonal display size, we use the Pythagorean Theorem,

$$a^2 + b^2 = c^2, \quad (1)$$

where a and b are the horizontal and vertical screen sizes, respectively, and c is the screen (diagonal) size. Note that a and b in Eq. (1) is dependent on the display format. For example, the old American standard, NTSC, had a 4:3 aspect ratio, while the new standard for HDTV has moved to a 16:9 aspect ratio. The aspect ratio is a comparison of the horizontal to vertical sizes of the screen.

Figure 2. Example of the layout of an equation and the text body around the equation.

I know, I know, this Photon Snacks is quite pedantic, and you might be rolling your eyes, but there are reasons for following these rules:

- Using *italics* for standard parameters makes them easier to find in the text and also delineates that they are variables/parameters, such as the word a or the variable a ,
- Symbols that are in **bold** in your textbooks are vectors comprised of numbers giving position and direction (e.g., a geometrical ray) or matrices that give you a wealth of information (such as an ABCD matrix for doing propagation through a lens),
- A substitute for the bold for a vector is to place an arrow above the character used, such as \vec{a} ,
- If you do not define the parameters, I can guarantee that readers will get confused. It is already hard to read someone's work, so help out the readers and make it as accessible as you can, and
- Finally, the equation is part of the text – it is to be read like the body of the text.

All of this can be difficult to remember, but the journal publishers have templates that you can download for word processing programs, like Word, LaTeX, and others. See these examples:

- SPIE: [sample manuscripts and Microsoft Word Templates](#),
- SPIE: [LaTeX style files for the Proceedings of the SPIE](#) at Ken Hanson's website, and
- OSA: [style guides and templates for OSA Journals](#).

Note that these links and the files that you can download go into the gory details about not only writing equations, but also layout out of the text, writing references, and so forth. There is a "science" to writing a scientific manuscript.

You are encouraged to use an equation or formula editor within your word processor – it saves defaults and makes the process easy once you have set it up with the journal requirements.

MathType has been the standard in the community for some time. Microsoft Word has integrated an equation editor into its flagship software (see Fig. 3 from my Mac using Microsoft Word for Mac Version 16), but it appears that some publishers do not recommend it (see the OSA template site and links therein). For LaTeX there are standard commands that can be used. You can find out more about equation editors at Wikipedia, including links to the many ones available.¹ Interestingly, historically the first equation editor developed was MacEquation, (per my understanding, but such cannot be found with certainty on the internet) and it was written by Dennis Venable while he was a PhD student at The Institute of Optics, University of Rochester in the 1980s. You can see reference to such in the acknowledgements for *Modern Optics* by B. (or R.)D. Guenther first published around 1990.²

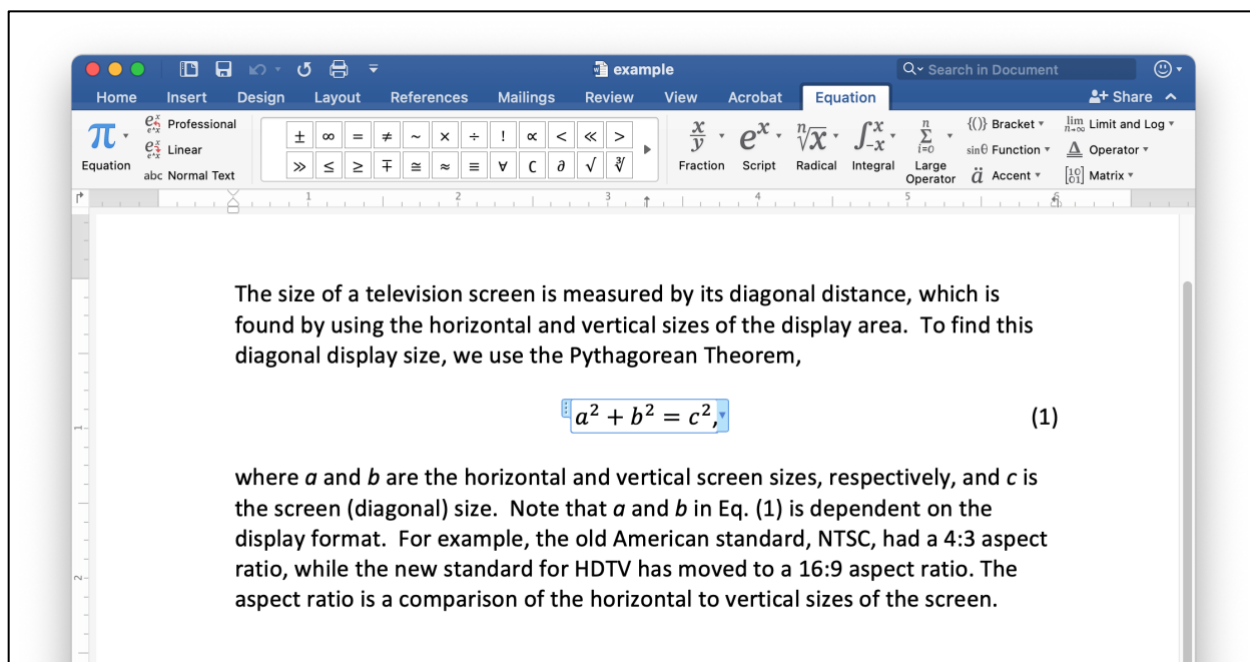


Figure 3. The Microsoft Word for Mac Version 16 equation editor used for Fig. 2.

Finally, visit professor webpages to find links to their papers. From there you can read about their research and take a look at the formatting of their papers. As an example (and a plug for my work!) look at my [publications](#). Note some of the links may be broken on this page – let me know if you find one.

Photon Snacks is a column for *Light Bytes* edited by John Koshel, Associate Dean for Undergraduate Affairs in the Wyant College of Optical Sciences. You can find the previously written articles at <https://wp.optics.arizona.edu/jkoshel/photon-snacks/>. Additionally, make suggestions for articles (or even write one!) by emailing jkoshel@optics.arizona.edu or by visiting the survey anytime at <https://forms.gle/ibC9LhPemeniJwhv9>.

¹ https://en.wikipedia.org/wiki/Formula_editor, accessed 29 April 2021.

²https://books.google.com/books?id=9iigCgAAQBAJ&pg=PR8&lpg=PR8&dq=Denis+Venable+equation&source=bl&ots=0Ws3z4QT9L&sig=ACfU3U2huZyqBYShFS6BYcELXfn-gNon4A&hl=en&sa=X&ved=2ahUKewjx5_e_1KTwAhXZJDQIHT3zCzMQ6AEwBHoECAEQAw#v=onepage&q=Denis%20Venable%20equation&f=false, searched for and found 29 April 2021.