I recall on my time as a first year graduate student taking a course on radiologic physics and radiation dosimetry and remember well seeing this equation:

$$\frac{d\_{e}σ}{dΩ\_{φ}}=\frac{r\_{0}^{2}}{2}\left(\frac{hν^{'}}{hν}\right)^{2}\left(\frac{hν}{hν^{'}}+\frac{hν^{'}}{hν}-sin^{2}φ\right)$$

and focusing too much on the right side of the equation without considering what the meaning of the left side was. Why was I so focused on the right side? Because I did not yet have great ability to use computational mathematics (i.e. Matlab). Therefore on any practice problem or homework assignment, the majority of the effort was spent inputting in the values correctly into a calculator. Later, I started using Matlab for my graduate research projects and then I realized that the right side is trivial if you have the proper tools such as Matlab.

The purpose of this project is to introduce students in a radiologic physics and radiation dosimetry course how to use Matlab to reduce a complex equation to a manageable entity. Then it is easier to look at the expression not in terms of the complex input parameters but rather on the nature and meaning of the output of the equation.

The project is set in four parts. The first part is using the above equation to recreate a plot in the textbook of $\frac{d\_{e}σ}{dΩ\_{φ}}$ with respect to $φ$. This allows the students to validate the script they create in Matlab because they have a known result for their script. For this part I assess whether the student could correctly replicate the plot.

In the next step they repeat the exercise on a related differential cross section (energy transfer cross section $\frac{d\_{e}σ\_{tr}}{dΩ\_{φ}}$, but this time the textbook does not have a figure to compare the result to explicitly. However if they understand the concept, an easy spot check of the output values can be made. I assess student understanding based on how they explain the plot of the differential $\frac{d\_{e}σ\_{tr}}{dΩ\_{φ}}$ with respect to $φ$ and if they can devise a way to cross check (or validate) the unknown differential $\frac{d\_{e}σ\_{tr}}{dΩ\_{φ}}$ with the known differential from the previous step $\frac{d\_{e}σ}{dΩ\_{φ}}$.

For the third step I assess the student ability to qualitatively answer the two questions.

For the fourth step I assess if they can explain the relationship of the previous differentials but now plotted with respect to the electron energy and explain why the shape of the plot changed.

Proficiency in Matlab is not a course goal so I don’t base the student assessment on the quality of the Matlab programming. The goal of this project is for the student to have a better understanding of how to use the Klein-Nishina cross section to understand how the Compton effect is manifest.