Starting out tutorials:

<http://homepages.cae.wisc.edu/~bohm/neep412/lucasMCNPTutorialspring2010.pdf>

<http://homepages.cae.wisc.edu/~bohm/neep412/runningmcnp.txt>

If have trouble running plot:

Make sure xming is installed and running first

Follow these instruction to modify the .bat file, section is “Plotting with xming”:

<https://mcnp.lanl.gov/mcnp_faq.shtml>

Try out threading, mentioned on that page as well. Doesn’t work with some cards, I couldn’t get it to work with a mesh.

1. Setup the geometry, set the environment to air
   1. Create a volume of water that is 10 cm thick x 1m x 1m that is centered 50 cm below the tungsten target
2. Setup the physics to work with both photons and electrons
   1. Set the cutoff energy for both electrons and photons to be 1kev
3. Verify particles are originating evenly spread across the 8mm area
   1. Review the print110 output for this
4. Starting with 50 kv electrons from the source, determine the spectrum of photons that go through the top surface of the water phantom
   1. Tally and plot the energy spectrum, either by taking the data out of the output file (easier), or using the MCNP plotting functions (relatively harder, I haven’t done this personally but I know this is done commonly so it can be done)
      1. Be sure to have enough energy bins, at mimimum one every 1 kev
   2. Experiment with different numbers of initial particles in the simulation
5. Change to instead use 100 kv electrons
   1. Plot the energy spectrum again
6. Insert a 1mm thick piece of aluminum just below the tungsten target
   1. Plot the spectrum in the water phantom
7. Add an additional 0.5 mm of copper just below the aluminum
   1. Plot the spectrum in the water phantom
8. Instead of using a simple surface tally, create a mesh tally at that same position, our goal is to see the 2 dimensional field size and shape
   1. Use the tmesh tally (type 3) to create a mesh that is 1 cm thick at 50 cm from the tungsten. The mesh only needs to be 1 unit thick in the z direction, but adjust the mesh qualities in the other dimensions as needed.
   2. Figure out how you want to plot this data. If you want to extract it to plot in matlab, look into using the “gridconv” feature.
      1. If you can figure out how to plot this with the MCNP plot command that would be awesome, but not necessary
9. As a bonus, feel free to start looking into the surface source write (SSW) and surface source read (SSR) functions which can be really helpful

Neutron Testing Goals:

Working to develop a model system for our IND neutron line

1. Create a neutron source that simulated what we have measured downstairs
   1. Use the spectrum that I sent (excel file) as the spectrum of emitted source particles
   2. Have the source be a disc once again, disc radius of .75 cm
   3. Have the neutrons be released in a cone from the disc source
      1. Make it a 40 degree cone shape
   4. Verify the source spread is correct by using a fine mesh that is about 10 cm away and perpendicular to the beam direction
      1. This should allow you to show the particle spread pattern at this distance and hopefully show up as a circle
      2. Should also measure the spectrum at this plane (perhaps make a thin structure at the same point) to verify the spectrum is correct
2. Input the borated polyethylene sheet
   1. Need to research the different neutron cross section options, I’m not sure what is best so finding a reason to pick one over another is key
3. Start to figure out the shielding performance of the material.
   1. Start with a 1” thick piece of the material
   2. Apply a monoenergetic neutron source (not our IND spectrum)
   3. Determine the energy deposition on the side near the source vs the side away from the source
   4. See how this compares to the projected performance that is graphed on page
   5. I would recommend trying this with something like 1 Mev neutrons and a 2.2 inch thick piece of material and see if you really cut 90% of the flux
   6. It would also be helpful to confirm the material with photons (pg 3 of the data sheet, so if you want to test that as well that would be nice)
   7. Then try doing this with our spectrum after the monoenergetic results look to be in agreement with what is specified.
   8. Try changing the thickness of the shielding material (try 1,2,5, and 10 cm perhaps) and see how the energy deposition from our spectrum changes
4. Our goal is to have the window that the mouse heart is exposed to be at a 60 degrees off axis angle from the target (this is where the spectrum was measures and where we do our experiments now). Don’t worry about this angle to start with though, since we’ll work on orientation of the shielding at a later time. To start now, we want approximately a 1 cm strip of the mouse thorax exposed, with the areas above it and below(head and lower body) shielded. Start by trying to build a very basic shield that is 10 cm thick to achieve this. Use the IND spectrum as a source.
   1. Use a mesh to map the neutron energy deposition in the area below the shielding
   2. Plot the mesh, hopefully you can see an increase in energy deposition in the area that was not shielded.
5. It would also be helpful to begin reviewing how we can potentially measure the energy deposition during an experiment with the use of radiochromic film. I would encourage you to google “Gafchromic EBT3” to get a general understanding of how these films function. After that, read this paper and see if you follow their reasoning: <http://iopscience.iop.org/article/10.1088/0031-9155/58/5/1391/meta>