Three-Dimensional Graphing with *Mathematica*

Basic Options

Let's start with the basics: **`Plot3D[x*y*Cos[x],{x,0,4Pi},{y,0,10}]`**

Now, adjust the scale: **`Plot3D[x*y*Cos[x],{x,0,4Pi},{y,0,10},BoxRatios->{1,1,1}]`**
Remember: You don't have to retype it. Go back to the original code and insert the new part.

Fix the axes: **`Plot3D[x*y*Cos[x],{x,0,4Pi},{y,0,10},BoxRatios->{1,1,1},AxesEdge->{{-1,-1},{-1,-1},{-1,-1}},AxesLabel->{x,y,z},Boxed-> False]`**

Want to rotate it? Insert the **`ViewPoint`** command as follows:
Add a **comma** after the last option. Go to the "Input" menu and choose "3D ViewPoint Selector..." Rotate the box to the view you want. Click "Paste." Finally, re-execute the code. Triple-Click on **`ViewPoint`** to select it quickly. Return to the "3D ViewPoint Selector" dialog box, make your change, paste, and re-execute.

Okay, so you want to rotate it *interactively*. On a new line, type and execute **`<<RealTime3D``** (backwards apostrophe)
Re-execute the graph code. Notice what happens to the axes. Press "Ctrl" while dragging to zoom.
To put it back to normal mode, type and execute **`<<Default3D``** then re-execute your code.
You can always open the package **`<<Graphics`Animation``** to run **`SpinShow[`***graph***`]`** to spin with axes.
Hints for SpinShow: Name your graph something like **`graph=Plot3D[...]`** and execute that before SpinShow. Double-click.

Let's smooth it out: **`Plot3D[x*y*Cos[x]....Boxed->False,PlotPoints->{40,5}]`**
Try switching the **`40`** and **`5`** to see what happens. What if you just put **`PlotPoints->40`** (no **`{}`**)?
Now add the option **`...,Mesh->False]`**

Cylindrical and Spherical Coordinates

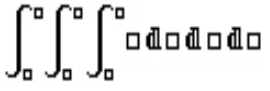
★First, open the package: **`<<Graphics`ParametricPlot3D``** (no spaces)

Here are some examples to play with. Note: You can insert some options described above to make it look better.
Keep in mind: Rectangular $z = f(x, y)$ Cylindrical $z = f(r, \theta)$ Spherical $\rho = f(\phi, \theta)$

`CylindricalPlot3D[r^2 Cos[theta]Sin[3theta],{r,0,1},{theta,0,2Pi}]`

For the next two, make sure you are using **`<<RealTime3D``**
`SphericalPlot3D[4Cos[2theta]Sin[2phi],{phi,0,Pi},{theta,0,2Pi}]`
`SphericalPlot3D[4Cos[2theta]Sin[2phi],{theta,0,2Pi},{phi,0,Pi}]`
Note the difference. Correct: phi comes first as in (ρ, ϕ, θ). Try **`PlotPoints->40`** to smooth these out.

Graph $z = x^2 + y^2$ using cylindrical coordinates. (Bounded by the plane $z = 1$)
Graph $x^2 + y^2 + z^2 = 2$ using spherical coordinates.
Graph the solid that is enclosed by these two graphs. Name graphs and use **`Show[`***graph1***`,`***graph2***`]`** to view.
You will need to adjust the domain of the sphere.

Write out a ***triple integral in rectangular coordinates*** needed to find the volume of this solid. Use the command **`Integrate[`***function***`,{`***variable***`,`***lowerlimit***`,`***upperlimit***`}]`** or the *basic input palette* to calculate the volume.
You can nest the functions like **`Integrate[Integrate[...,{...}],{...}]`** or 

Use **`N[%]`** to get a numerical approximation for the previous output.
Find the volume using a ***triple integral in cylindrical coordinates***. Compare the results.