

EURECOM

## 3D GRAPH COURSE

### LAB N°1 : Blender

Author: **P. Gros,**  
Environment: **Blender**

## Introduction

The goal of this Lab is to experiment the concepts presented in the course. During this TP you are going to use the Blender program that will allow you to compute images from a 3D scene that you define interactively. You may run the Blender software using (**start – AllPrograms - Blender Foundation – Blender - blender.exe**). You may find all the files referenced in that document at the following location:

**\\datas\teaching\courses\3DGraph\blender.**

You will send your answers to each question by email to [gros@eurecom.fr](mailto:gros@eurecom.fr) with the subject message being “blender TP”. The message should include the answers to each question as well as the attached q1.blend, q2.blend, q3-1.blend, q3-2.blend, q3-3.blend, q3-4.blend, q4-1.blend, q4-2.blend, q4-3.blend, q4-4.blend, and q5.blend files.

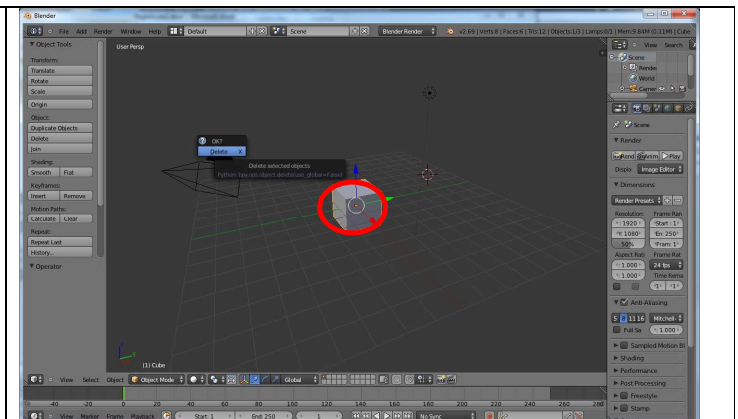
### Launching Blender

To begin :

- Open blender
- Select the default cube (right click on it)
- Delete it (delete key)
- Validate

Navigating in the 3D View :

- Right button click = selecting objects
- Left button click = new cursor position
- Middle button = modify view point

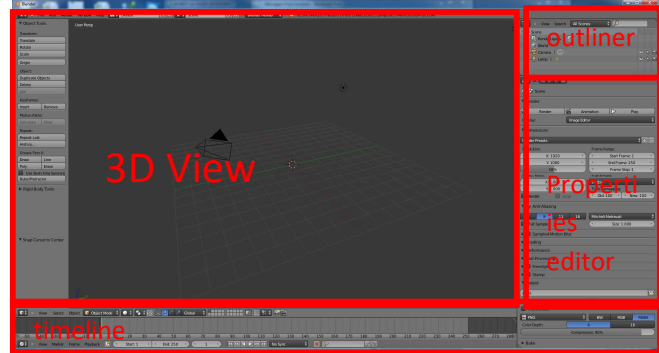


- Shift Middle button = Pan view point

## The interface

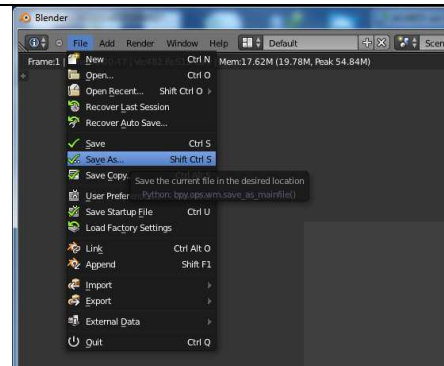
When you launch blender the interface is composed of four parts (this is customizable) :

- The 3D view (where you see and interact with objects)
- The properties editor (where you can edit materials and textures)
- The outliner (that shows the hierarchy (unfortunately the hierarchy of blender is mostly flat))
- The timeline, used for animation



## Saving Your Work

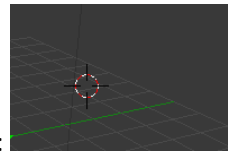
At each important step do not forget to save your work in a separate ".blend" file.



## Inserting an Object

You insert an object by opening the add menu and inserting a shape. The object is inserted at the position of the cursor.

You can put back the cursor at the center of the world by pressing **Shift+S** and choosing "cursor to center"



The cursor :

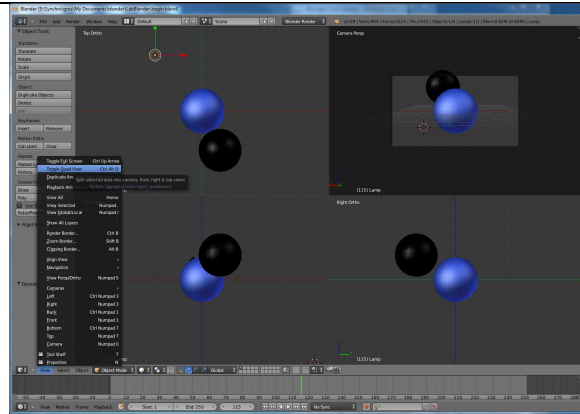
## Moving the camera

As it has already been said you can modify the viewpoint by moving the mouse around with the middle button pushed.

Once the viewpoint is correct, you can set the camera to the viewpoint by typing **Ctrl-Alt-0**

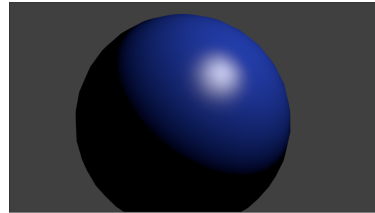
## Toogle to Quad 3D View

It is often very interesting to see not only the 3D view but also the four projection (top, front and right), you may then interact in planes which constrains your modification. This is done either by the menu (see on the right) or by typing **Ctrl-Alt-Q**. The same action will put you back in full 3D View .



## Compute an Image

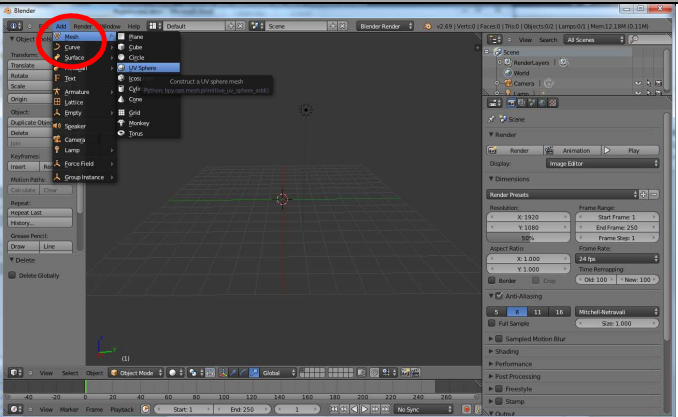
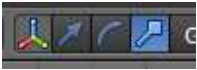
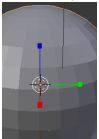
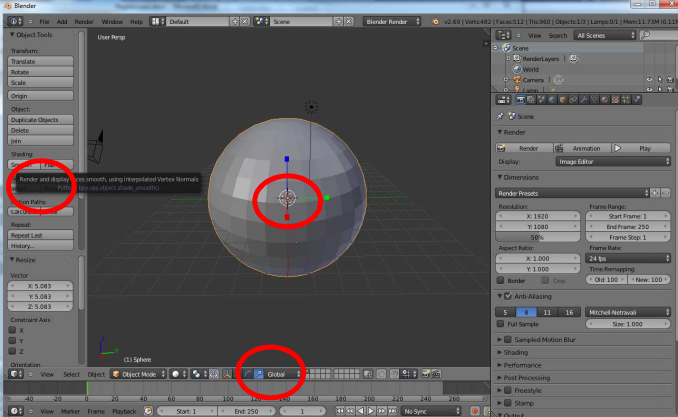

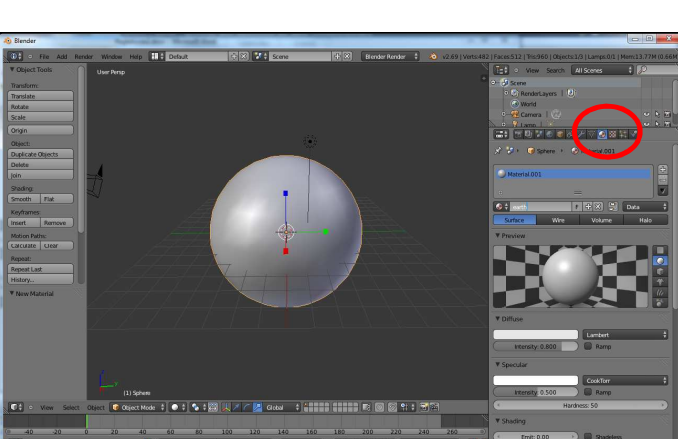

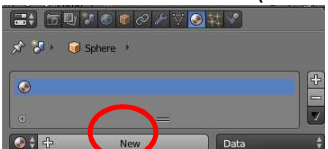
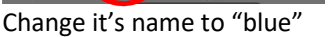
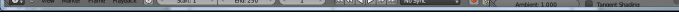
Press F12 (to compute an image)  
And ESC to exit from the image view

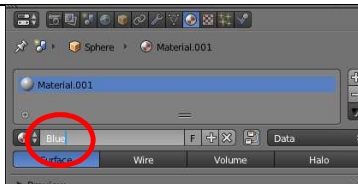


# Subject

## Question N°1 : First experiments, objects, materials, shading :

The goal of this question is to have a first experience with the blender interface, : create an object, modify some parameters (size, smoothness) and experiment with the materials (diffuse and specular coefficients). Please do some experiments and answer to the question in the last row (value of In specular intensity and hardness for the four image exemples).

instruction	illustration
<p>Create a UV sphere (add-Mesh-UVsphere)</p>	
<p>Make it bigger : Select the scale tool</p>  <p>modify the size of the white circle</p> 	
<p>Make it smooth</p> 	
<p>Select the sphere (right click)</p>  <p>Go to the material editor</p>  <p>Create a new material (click new)</p>  <p>Change it's name to "blue"</p>	



We are going to modify the Kd and Ks value which are defined in the diffuse and specular tabs in the material editor:

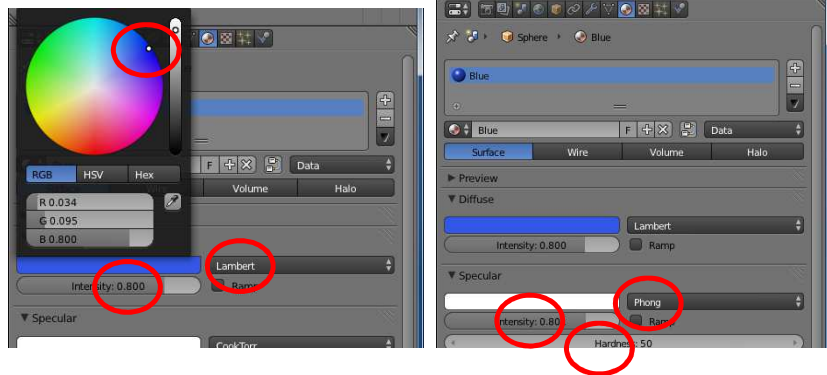
$$\{ K_d \} = \{ \text{color} \} \times \text{intensity}$$

$$\{ K_s \} = \{ \text{color} \} \times \text{intensity}$$

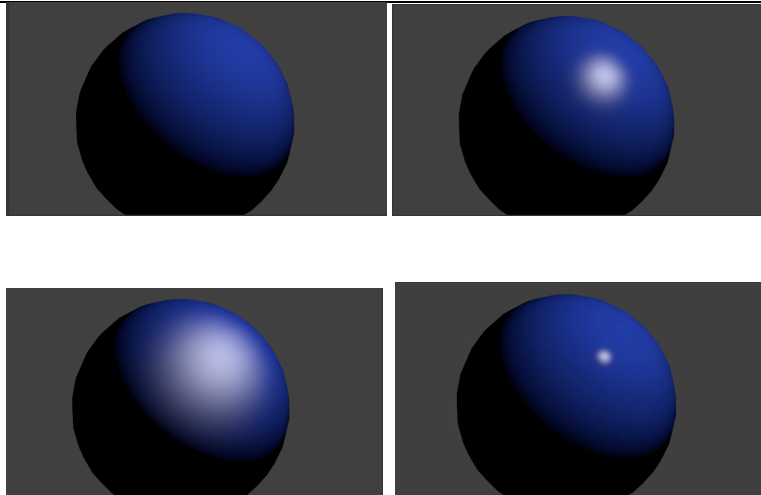
- Set the diffuse color to blue
- Set the diffuse intensity to 0.8
- Set the type to "Lambert"

We don't want specularities so Ks should be 0 :

- Set the specular intensity to 0
- Set the type to "Phong"
- Set the Hardness (ns) to 50



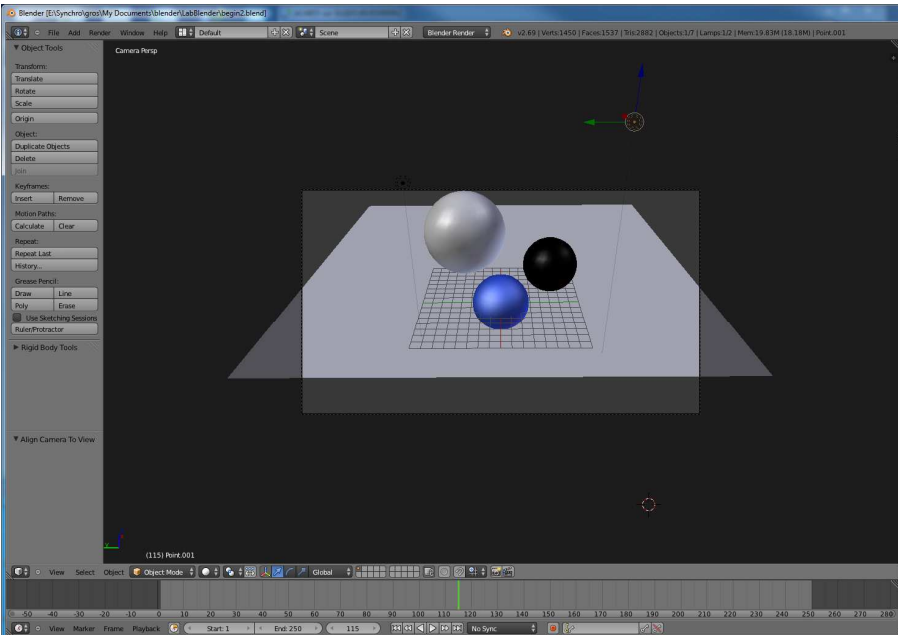
Press F12 (to compute an image)  
(The image should look like the upper left image on the right)  
Save your work (in a **q1.blend** file)



Then modify the specular intensity and the hardness values in order to obtain images that look like the previous ones and give the values in your answer.

## Question N°2 : Create a scene, reflection, refraction, cast shadows :

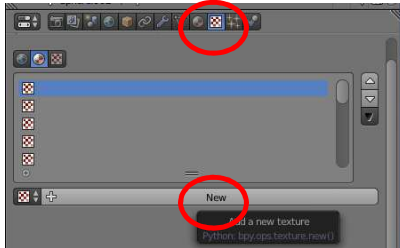
In this second question, starting from the previous question, we are going to add new objects in order to define a very simple scene made of a plane and 3 spheres. In this question you are going to manipulate the camera, add new objects and lights and experiment with refraction and reflection of the whitted algorithm.

instruction	illustration
<p>Starting from the previous scene (kipping the blue sphere) add :</p> <ul style="list-style-type: none"> <li>• two new spheres</li> <li>• One plane</li> <li>• Modify their size and positions so that it look like the image on the right. (no intersection between objects).</li> <li>• A new point lamp (add-lamp-point) and modify the position of both lamp so that they are located on each side of the viewer on left and on the right.</li> </ul> <p>Note : This steps is probably easier to do in quad view mode :</p> <p><b>Ctrl-Alt-Q</b></p> <p>Note : You can change your view point by pushing the mouse central button and move around</p> <p>Once the position of the viewpoint is ok, set the camera to that position by typing <b>Ctrl-Alt-0</b></p>	 <p>The illustration shows the Blender 2.79 interface. The 3D Viewport displays a scene with a white plane on a grid. Three spheres are placed on the plane: a white one, a black one, and a blue one. The camera is positioned above the plane, and the scene is rendered in a perspective view. The interface includes a top menu bar, a left sidebar with toolshelves, and a bottom status bar.</p>

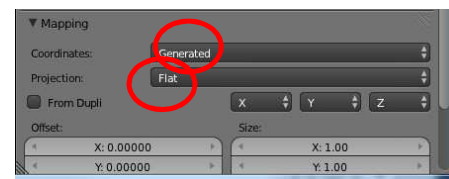
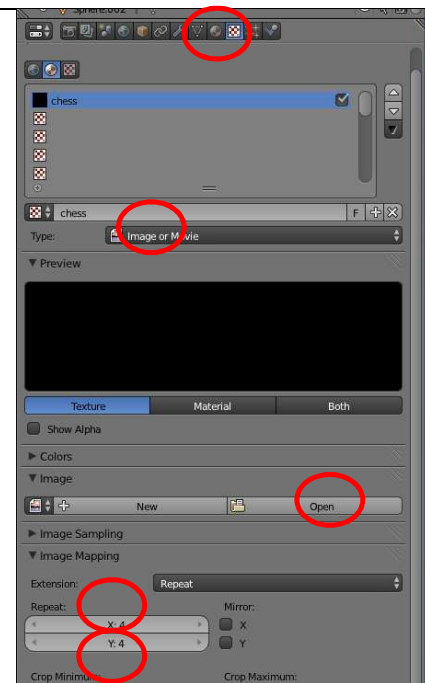
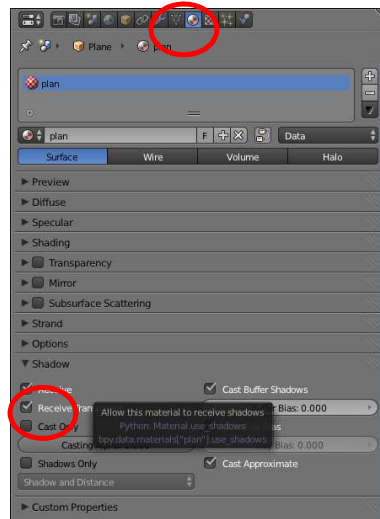
Select the plane (left click on it) and apply a chess texture to the plane :

- New material with default diffuse and specular values
- Modify the shadow tab by checking the “receive transparent” box.

Create a new texture in the texture editor

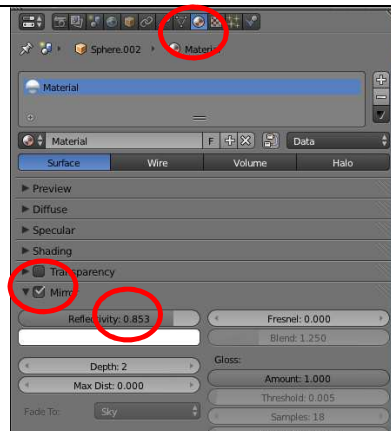


- Give it a type “Image or Movie”
- Select a file (the chess.jpg)
- Modify the X and Y “repeat” values in the “image sampling” tab to 4 and 4
- Verify that the mapping is set to : “generated” and “Flat”.



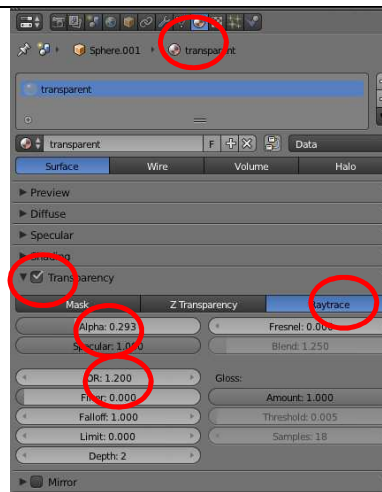
Select one of the new spheres and make it a mirror :

- New material with default diffuse and specular values
- Activate the “mirror” tab
- give the”Reflectivity” a 0.85 value.



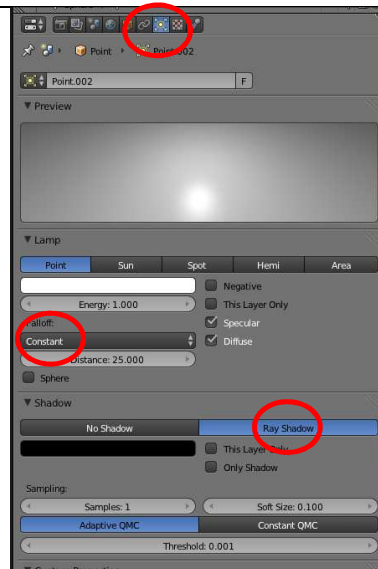
Select the other new sphere and make it transparent :

- New material with default diffuse and specular values
- Activate the “transparency” tab
- Select the “Raytrace” type (that will allow refraction to be computed)
- Set the value of alpha to 0.3 (0 is fully transparent)
- Set the value of IOR to 1.31

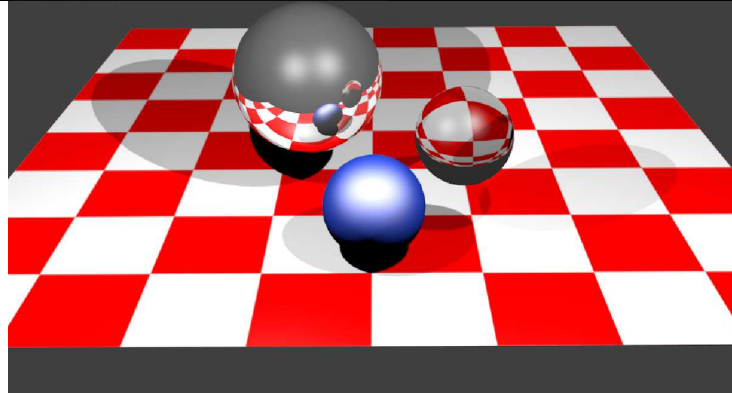


Select the lamp (one after the other) and modify them so that they cast shadow (they don't by default) :

- Select "Ray Shadow"
- Make the falloff Constant



Press F12 (to compute an image)  
*(The image should look like the left image on the right)*  
 Save your work (in a **q2.blend** file)



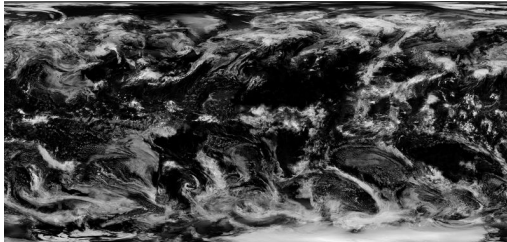
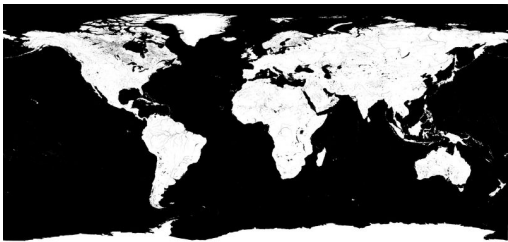
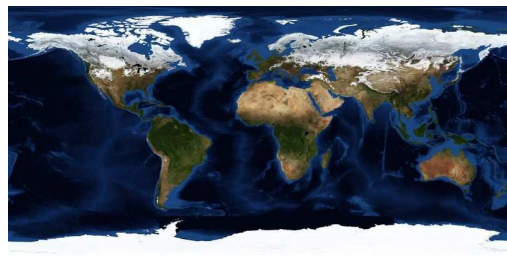
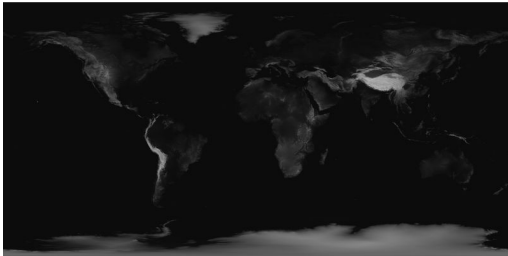
**Explain what you see and relate what you see with the value of the coefficients we have choosen.**  
**Please focus on the colors of the cast shadows on the plane, why the black shadow does not look realistic ?**  
**What do you think can be done in order to make that shadows more realistic ?**



### Question N°3 : Playing with textures, bumping, transparencies :

In this third question, the goal is to go a bit further in the manipulation of concepts presented in the course. For that purpose, we are going to model the earth with four textures applied to it :

- A bump map to sculpt the earth according to the mountain relief (modification to N).
- A Color map in order to render the diffuse aspect of the earth (applied to  $K_d$ )
- A specular map in order to make the ocean specular ( $K_s = 1$ ) and the ground diffuse only ( $K_s = 0$ )
- A transparency map in order to model the clouds

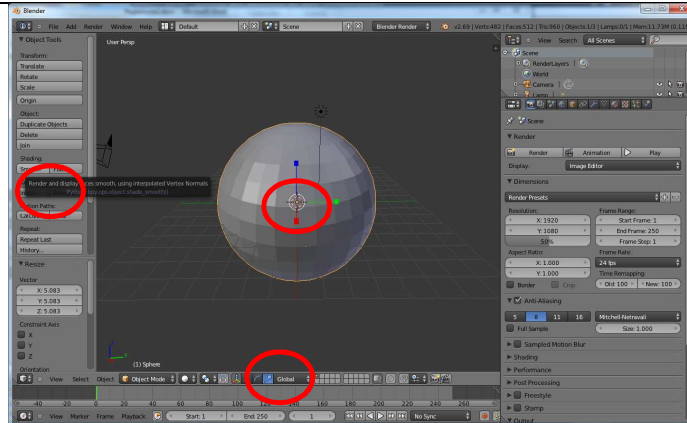


For that purpose you are going to start from a new empty scene.

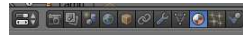
Please note that this question has been inspired by the tutorial available at the blender guru following address : <http://www.blenderguru.com/videos/create-a-realistic-earth/>

instruction	illustration
Create a UV sphere (add-Mesh-UVsphere)	A screenshot of the Blender 2.80 interface. The 'Add' menu is open, and the 'Mesh' option is selected. The 'UV Sphere' option is highlighted in the 'Mesh' submenu. The 'Add' button is circled in red.

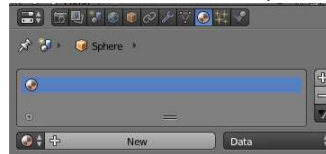
Make it bigger and make it smooth



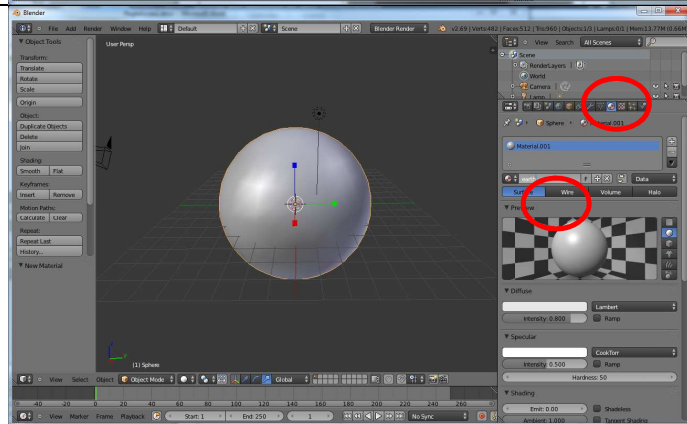
Select the sphere (right click)  
Go to the material editor



Create a new material (click new)



Change it's name to "earth"

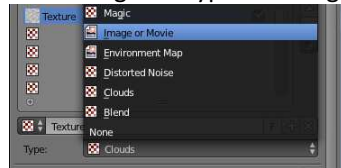


Goto the texture editor



Create a new texture (click new)

And change it's type to "Image or movie"



Open the bump image (image-open)

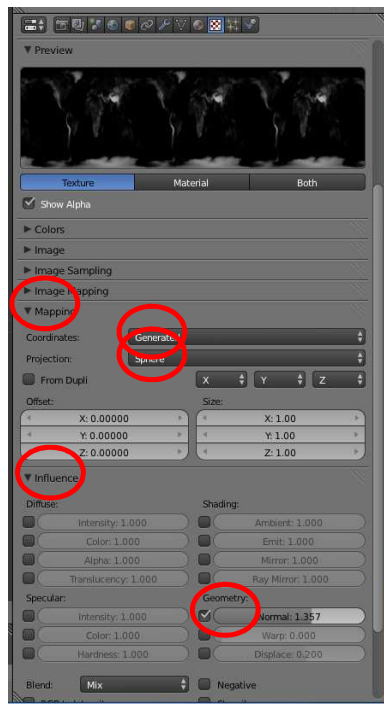


Choose the mapping type (on the right):


- Generated
- Sphere

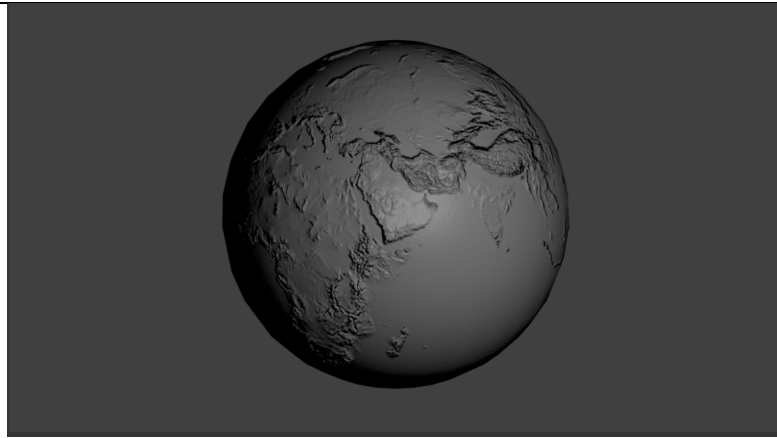
Apply it to to normal using the influence tab

Rename the texture "bump"



Position the camera in several steps....

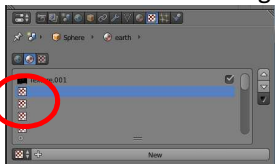
- Push the mouse central button and move around, once the view is ok, Ctr-Alt-0 to apply it to the camera (the camera from which you are going to compute the image)
- Press F12 (Esc to close)
- You will have to modify the position of the “lamp” which you can right click on and move using the translation tool 



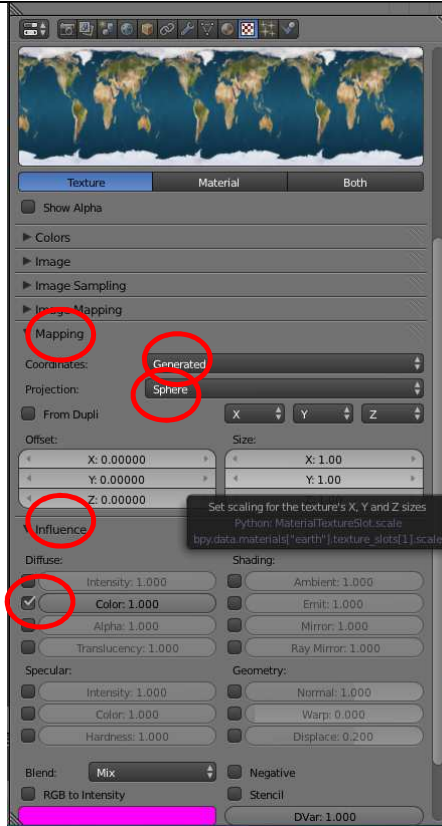
Save your work to the **q3-1.blend** file

We are now adding the diffusion map :

- Select the sphere (right click)
- Go to the texture editor, and add a new texture by clickin on a new texture slot and clicking new



- As previously choose the “Image or movie” type and rename the texture “color”
- Then open the correct texture file (image-open)
- Put the correct mapping (as previously : “generated” and “sphere”)
- open the influence tab and select color
- 



Then render using F12

Save your work to the **q3-2.blend** file

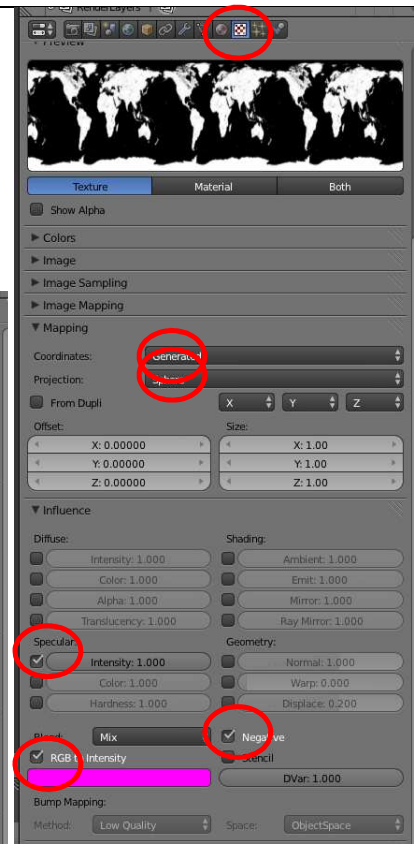
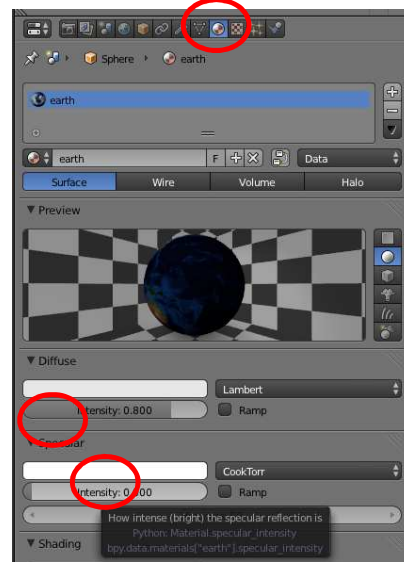


We first have to remove the “by default” specular aspect of the material :

- Select the material editor
- In the specular tab but the intensity to 0

And then add a texture that will control the specular aspect of the material, so, in the texture editor :

- Create a new texture (as previously)
- Open the corresponding image file (as previously)
- Define the mapping (as previously)
- On the influence tab :
  - Select the intensity slot in the specular part (apply the texture to the specular coef).
  - Select RGB to Intensity (map an RGB to a one dimensional intensity)
  - Select negative (in order to have 1 for ocean and 0 for continents).



Then render using F12

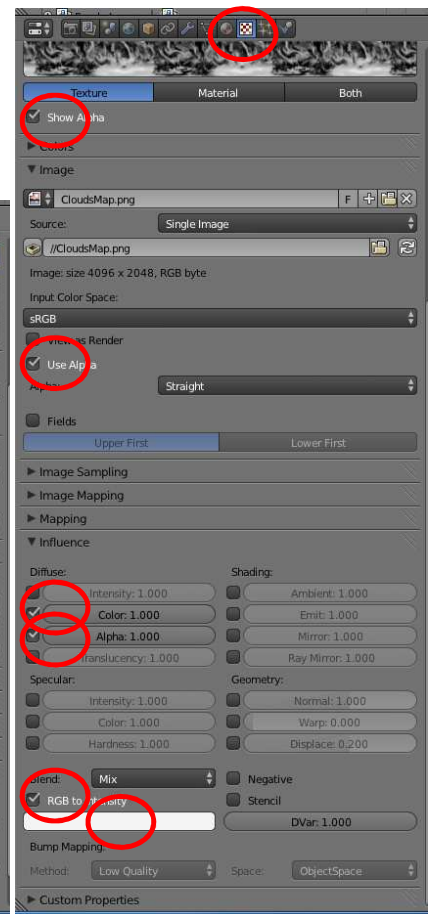
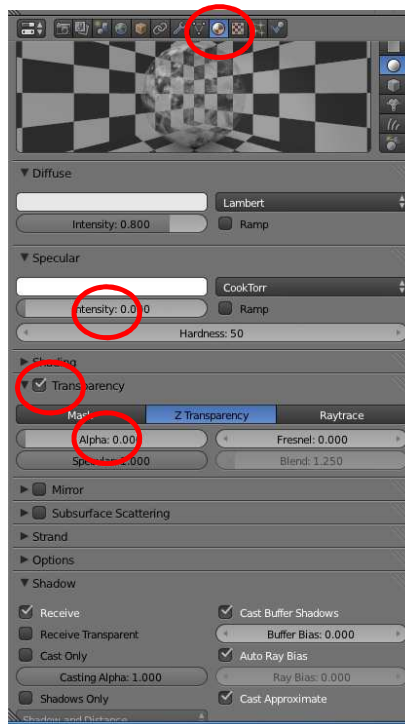
Save your work to the **q3-3.blend** file



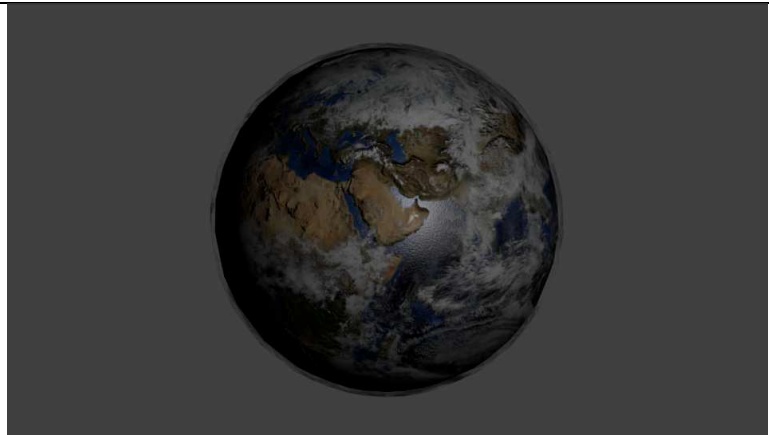
- For the material of the sphere you are going to modify a parameter in the shadow tab : select “receive transparency” (it’s a hack from blender (no real theoretic interest). This will allow the sphere to receive light through the clouds...



- Put back the cursor at the center of the earth (Shift+S)
- Add a new UV-Sphere and make it slightly bigger than the earth (same center, slightly bigger radius)
- Create a new material in the material editor (call it “cloud”) and
  - set its specular intensity to 0
  - active its transparency and set the alpha value to 0.
- Create a new texture in the texture editor of type “image or movie” and call it “cloud”
- Open the corresponding texture file
- Modify the texture so that :
  - Select show alpha
  - Select use alpha
  - define the mapping as previously (generated and sphere)
  - In the influence apply the texture to both color and alpha
  - Select RGB to Intensity (map an RGB to a one dimensional intensity)
  - Set the color to white (1, 1, 1)



Then render using F12  
Save your work to the **q3-4.blend** file



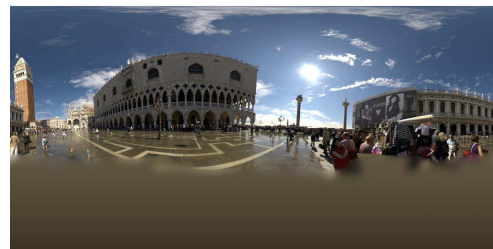
Explain the concepts behind each of the four steps, and relate that steps to the concepts we have seen in the course.



## Question N°4 : More textures, environment mapping and chrome effect

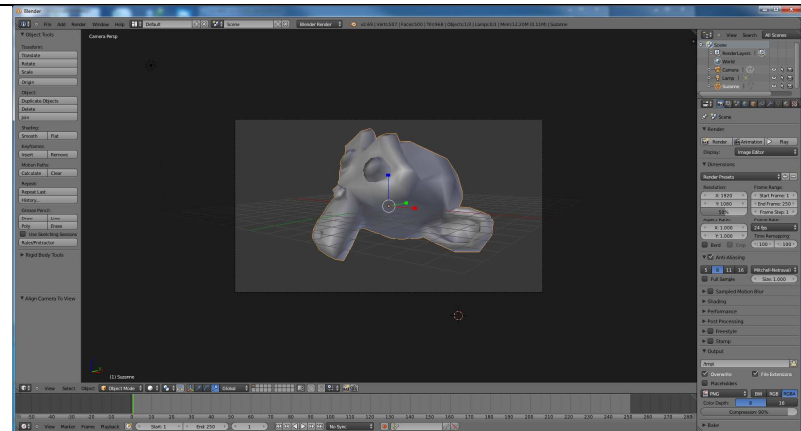
In this fourth question, we are going to play a little more with textures and illustrate the environment mapping effect that you will see in more details in the course. The idea is to play with two types of environment maps :

- The chrome effect (the idea being to use a reflection map to simulate a complex lightning process)
- The environment map (reflection of the environment) effect as described in the course.



instruction	illustration
Create a monkey	

Adjust a “nice” camera view

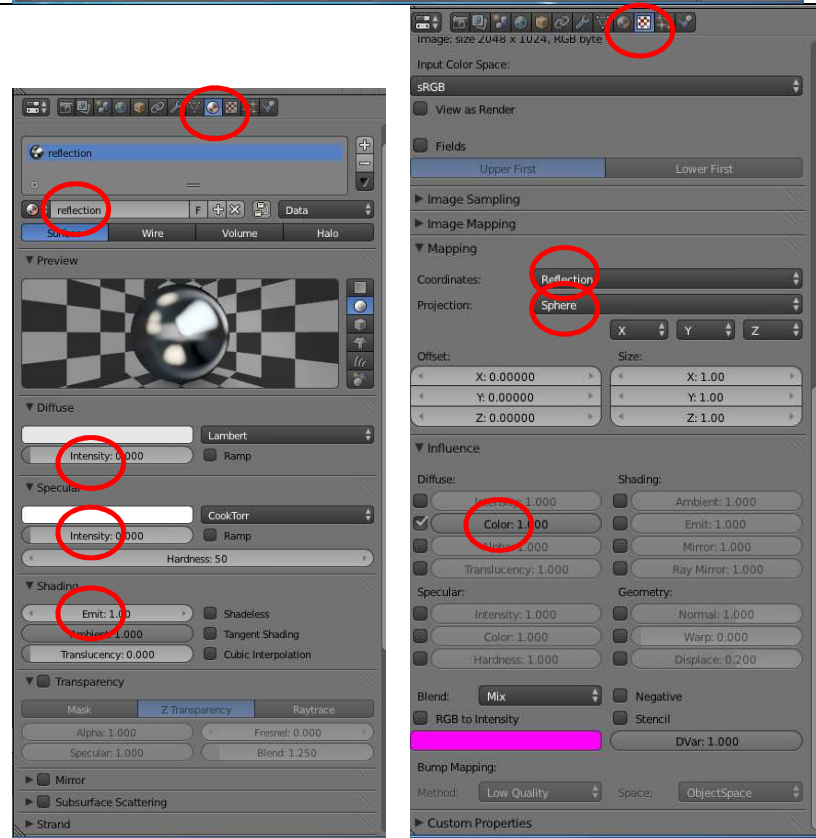


Create a new material, call it reflection and give it the following characteristics :

- Diffuse intensity = 0
- Specular intensity = 0
- Emit = 1 (in the shadow tab)

Create a new texture with a type as usual (image or movie) and load the “reflection.jpg” texture image. Set the influence to color and in the mapping tab do the following :

- Set the coordinate to reflection
- Set the projection to sphere



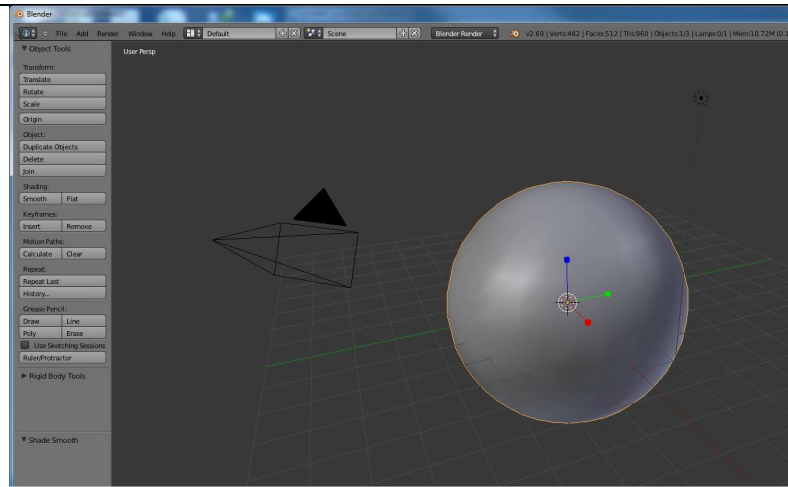
Then render using F12

Save your work to the **q4-1.blend** file





Create a new world  
Add a sphere at its center.  
Make it big and smooth

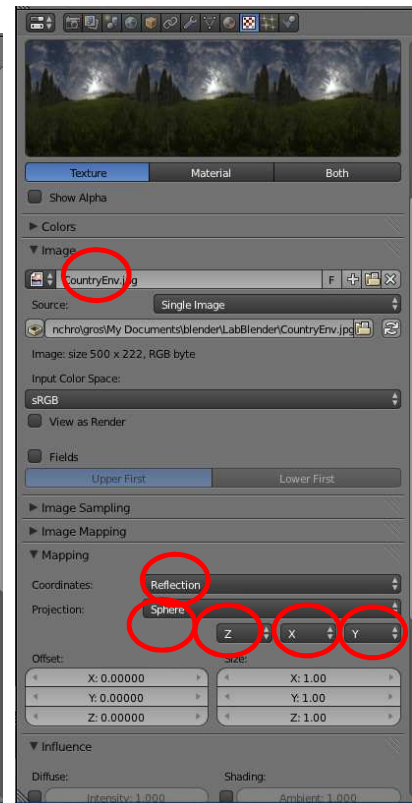
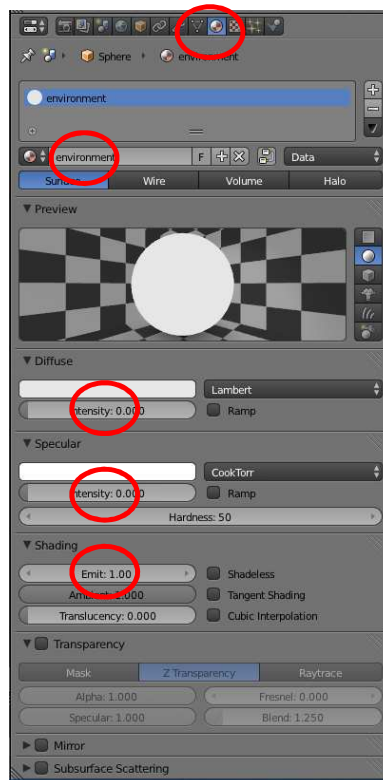


Create a new material, call it environment and give it the following characteristics :

- Diffuse intensity = 0
- Specular intensity = 0
- Emit = 1 (in the shadow tab)


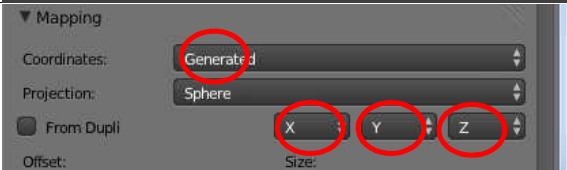

Create a new texture with a type as usual (image or movie) and load the "CountryEnv.jpg" texture image. Set the influence to color and in the mapping tab do the following :

- Set the coordinate to reflection
- Set the projection to sphere
- Modify the projection axis to Z X Y



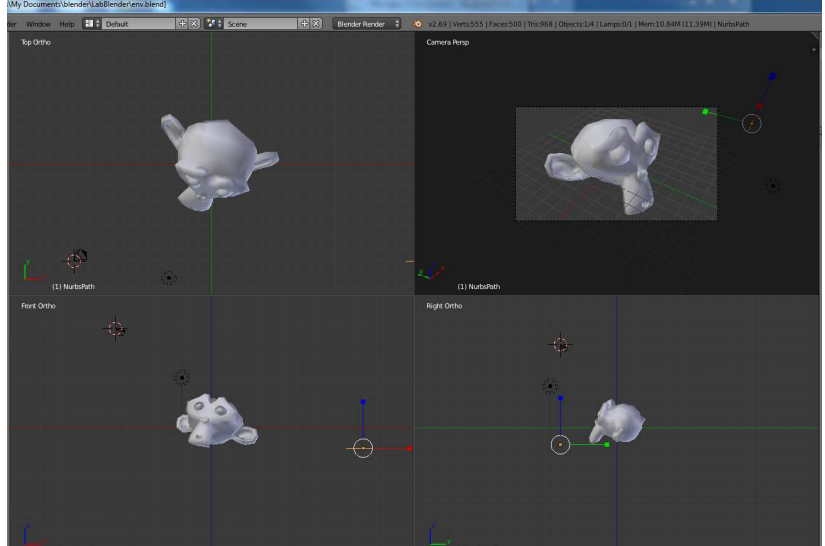
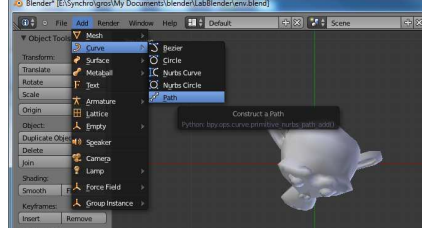
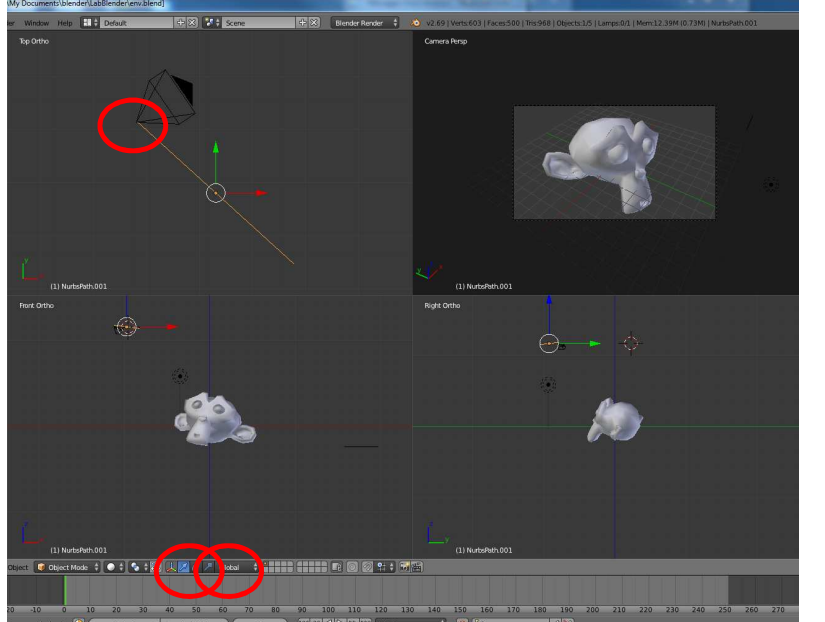
Then render using F12  
Save your work to the **q4-2.blend** file



<p>Modify the texture image to "PiazzaSanMarcoEnv.jpg". Then render using F12 Save your work to the <b>q4-3.blend</b> file</p>	
<p>Modify the parameters in the mapping tab to the following :</p> <ul style="list-style-type: none"> <li>• Set the coordinate to generated</li> <li>• Set the projection to sphere</li> <li>• Modify the projection axis to X Y Z</li> </ul>	
<p>Then render using F12 Save your work to the <b>q4-4.blend</b> file</p>	
<p>Please comment the resulting images and the parameters that where set to achieve the effect. Analyze the difference between the two last steps, what is according to your understanding the theoritical difference. how do you think is it possible to validate the reflection effect ?</p>	

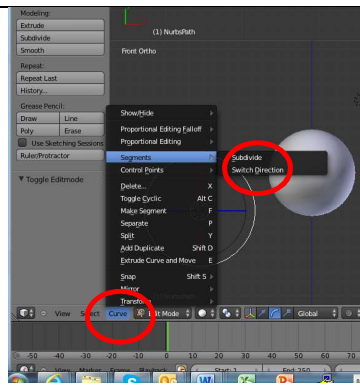
## Question N°5 : Animation, path, focus, chrome effect

In this fourth question, we are going to animate the position of the camera in order to make the chrome effect more evident :

instruction	illustration
<p>Load the g4-1.blend file you have already saved, (the monkey one).</p> <p>Switch to quad view : <b>Ctrl-Alt-Q</b></p> <p>Position the initial location of the camera</p> <p>Position the cursor where you would like the position of the animated camera to start from.</p>	
<p>Create a Path for the camera at that cursor position.</p> <p>This path will be the curve along which the camera is going to move. It is a free form curve (initially straight) that we are going to modify according to our needs.</p>	
<p>Zoom on the path in top view and precisely set the location of the path as well as its orientation so that it looks like on the right.</p>	

Note : by pressing TAB, you are going in edit mode, in edit mode you may see :

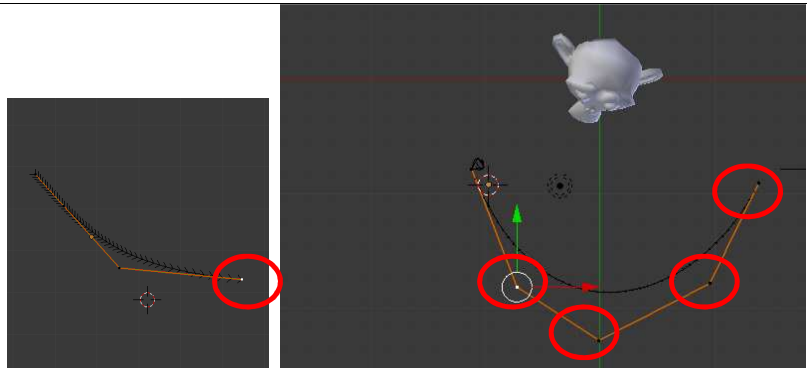
- arrows along the path (if the arrows are not in the correct way, you can either rotate by 180°) or select the “switch direction” option as shown on the right.
- 5 Control points



Pressing TAB again goes out of the edit mode

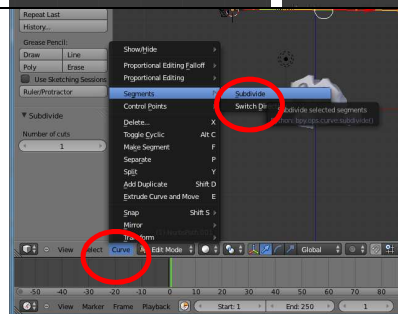
In edit mode, modify the end control point of the curve by right clicking on it and dragging it around to its final position (the final position of the camera), type enter to confirm the new position.

Do the same thing for the 3 other points so that you obtain a curve that look like the one on the far right.



You may have more control points by “subdividing” the curve. For that purpose, select all the points (with shift right click) and select the subdivide option as shown on the right. Then move the additional control points around as you wish.

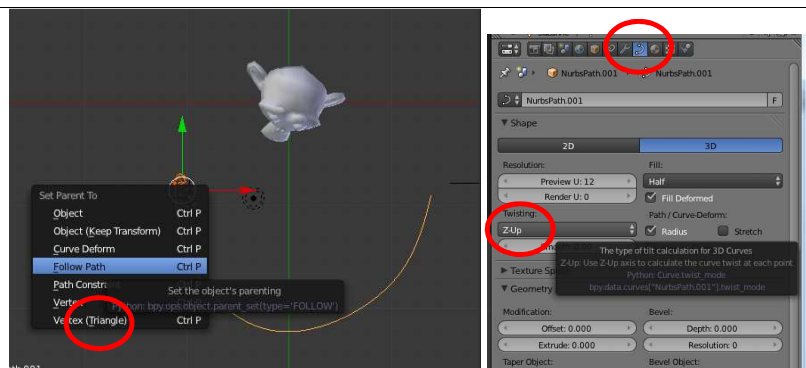
Note that when you select two control points and click on subdivide it adds a additional control point in-between.



Now, we are going to relate the camera and the path, for that purpose we have to (the order being important) :

1. Select the camera
2. Select the path
3. Type **Ctrl-P**
4. In the popup menu, select the “follow path” option

In the path editor select the twisting to “Z-Up”, this will guaranty that the camera is always up.

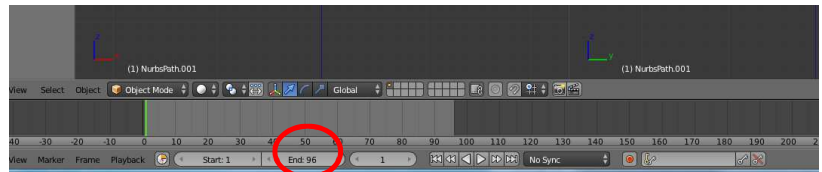
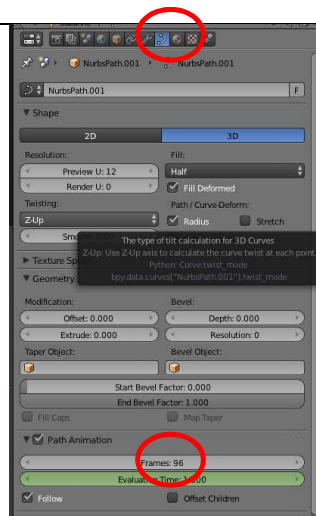


We have then to define the length of the animation at two places :

- In the path editor set the frame value to 96
- In the time line editor set the end of the animation to 96

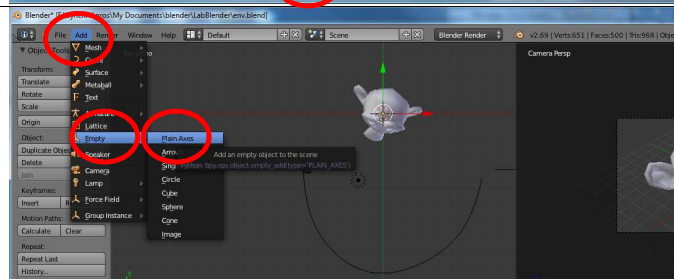
Type Alt-A to see the result

Interesting isn't it ?



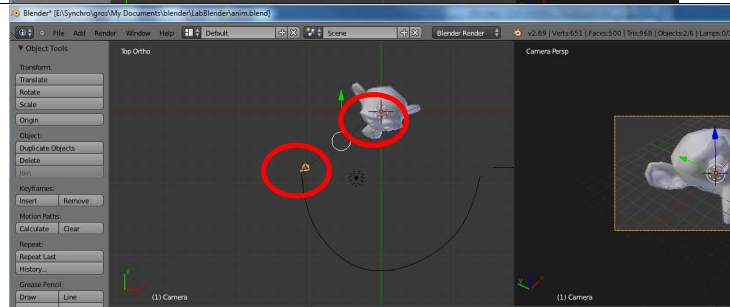
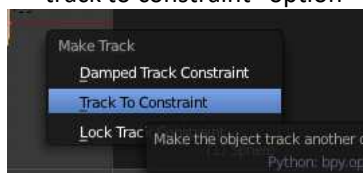
We are now going to do things so that the camera is always looking toward the monkey. For that purpose we are going to create what is called an “empty” object.

So first we are going to create this empty object at the same position as the monkey.



We then are going to link the camera to the “empty”, for that purpose we have to (the order being important) :

1. Select the camera
2. Select the empty
3. **Ctrl-T**
4. In the popup menu, select the “track to constraint” option

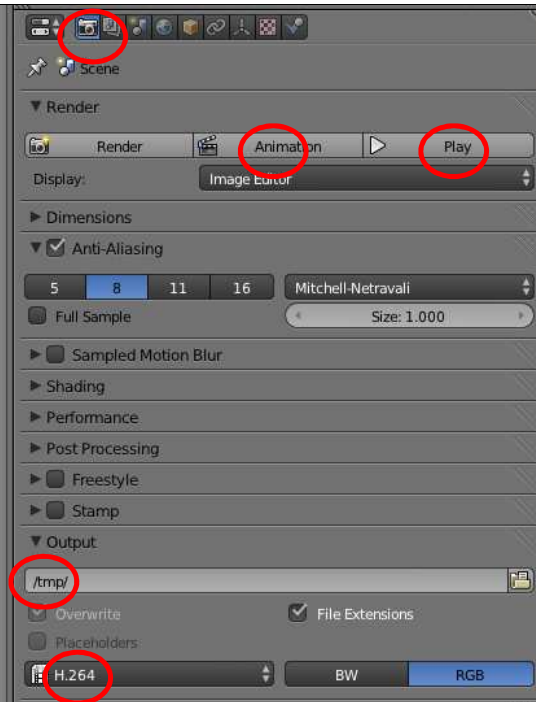


Type Alt-A to see the result  
Save your work to the **q5.blend** file

Then we are going to compute the final animation, for that purpose in the rendering editor :

- Select H.264 as the type of animation output.
- Verify where is the output of the animation (/tmp in this exemple).

Then compute the animation by clicking on the “Animation” button, an once it is computed play the animation by pushing the “play” button.



Please comment the resulting animation according to the chrome texture appearance when you turn around, why do you think a point on the object changes of color with the viewer position ? relate that effect to the previous question.