

Dynamic Lighting Tutorial For A6 Game Studio Version 6.20

By George Schneider



Our Wizard has been transported to the 21'st century to save the world from a runaway nuclear reactor. The hot pulsating nuclear core glows with a burning fire as it is about to explode and wipe out....

Hey wait a minute. What's going on with this scene? There's no glow to the reactor core, it's just a dull ugly grey color! Where is the burning light reflecting on the walls? This scene looks terrible. What went wrong?

SECTION 1: INTRODUCTION

I decided to write this tutorial about dynamic lighting, the new materials structure and how it can be used to affect the look of a game scene. This started because I was working on a small game, and got very frustrated with my attempts to use dynamic lighting. I tried tweaking different aspects of the lighting, but nothing I tried seemed to get the results I wanted. I read through the manual, searched the Forum and looked for any info I could find, but nothing was helping.

Well, one of the things I learned along time ago is that the best way to understand computer programming is to do it. If you program enough stuff, eventually it starts to sink in. Surely the same principle can apply to all of these different lighting options now available with A6!

But how do I go about explaining what the materials structure does, when I don't quite understand it myself. Then it came to me. I'll write program to let me adjust the different lighting options on any entity in my running game, on the fly! Then through scientific reasoning . . . or dumb luck, I would figure out how all this stuff interacts.

And that's what I did. I built a tool to help me adjust the lighting effects in any game that I might develop. And I've decided to share it with you. That's right, I'm going to give you a tool you can use in your games to dynamically adjust the lighting of various entities. If you are interested, I'll even show you how to write the tool. Somewhere along the way, I hope to make sense of the lighting effects options available in A6. And maybe we can even pick up a few C-Script programming concepts to make us better at game development!

Through this tutorial, and the Light Mixer tool, you'll be able to learn what some of the lighting effects do, and how they interact with each other in the game environment. When you are done with this tutorial you'll be able to put the tool into action in your own games and possibly determine how to make your game scenes look better! And since I've included how the tool was made, maybe you can even add your own improvements. We will take advantage of some of the new features of A6, such as manipulating an entity's .material structure and play around with other dynamic lighting features.

And all of this you get for the low low price of ... FREE?

Yeah, I've been thinking for a while that I need to give something back to the 3DGS game community, and here it is. Of course I am also entering this tutorial in the A6 Fall 2003 contest in hopes of winning a Pro Edition for A6, but hey, even if I don't win, I'll have that warm glowing feeling of sharing with the community!

What you will need

1. A6 Game Studio. I developed Light Mixer with the Commercial Edition 6.20. I don't know how much of the Dynamic Lighting features work with the Standard or Extra addition. From what I could tell from the manual many of them do work, so try it out your self and see.
2. A recent 3D accelerator (If you get ...T&L device detected at startup you're in good shape)
3. **DirectX 8.1** or better. (I am using 9.0)
4. Lightmx.zip which contains this tutorial and all the files you need.
5. This Tutorial

Sections In This Tutorial

1. Introduction

This section.

2. Getting Started

Setting up your 3DGS environment for this tutorial.

3. Using the Light Mixer

This goes through starting up the Reactor 'game' and how to use the Light Mixer tool to adjust various entities in the level.

4. Lighting Effects

Through the tool I'll show you how some of the dynamic lighting effects interact with each other.

5. Using Light Mixer in your Games

This is a one page explanation of how to use Light Mixer in your own game development!

Bonus: A tutorial on how to write Light Mixer.

Look for the file lmxTut1.pdf in the lghtmixr directory

Section 2: Getting Started

So, let's get started. Unzip the lightmx.zip file into the A6 games directory. It contains a directory called 'LightTut' which contains the tutorials matTut1.pdf and lmxTut1.pdf plus two sub folders called 'Reactor' and 'lghtmixr'. The subfolder "reactor", contains is a very, very simple level that you can use to test out the Light Mixer code. The subfolder called "lghtmixr" which contains the completed Light Mixer source code, along with the bit maps for the Light Mixer Panel.

I've tried to include something in these folders for everybody.

In the LightTut folder:

1. For those curious about lighting effects, try the tutorial MatTut1.pdf. With the help of the Light Mixer Control Panel, you can see how lighting effects interact with each other.
2. Also in MatTut1.pdf are instructions on how to install Light Mixer in YOUR games
3. For the experienced programmer, check out the tutorial lmxTut1.pdf. It covers how to code the Light Mixer Control Panel. This isn't 'lite' reading but give it a try.

In the Reactor Folder:

1. The reactor Game including all the files you need to build it with WED.
2. If you're just beginning to learn C-Script, check out reactor.wdl. The game code is fairly simple, with lots of comments on what it is doing.

In the Lghtmixr Folder:

1. All of the source code to the Light Mixer Control Panel program is in lmx.wdl. Advanced programmers with experience in pointers may want to skip the tutorial and just look through the code. It is heavily commented for your reading pleasure.
2. All of the bit maps necessary for the Light Mixer Control Panel

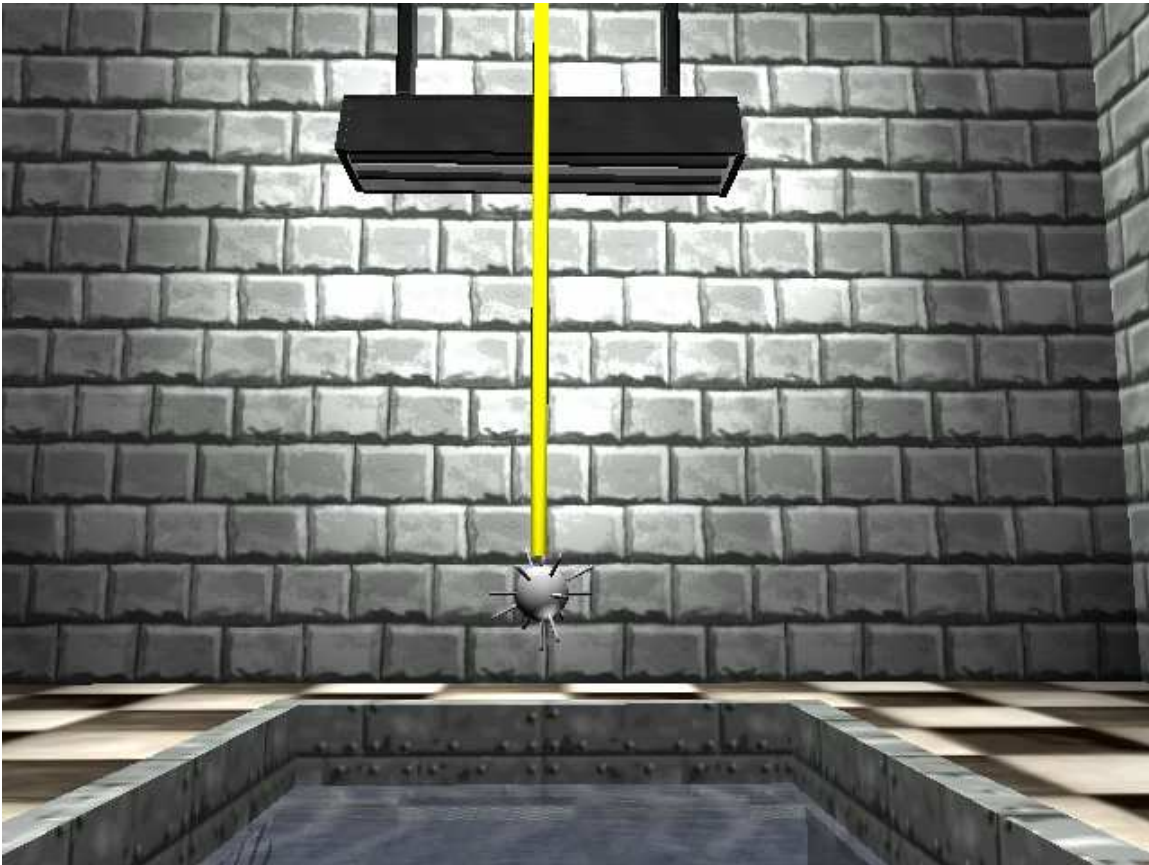
That's it, your ready to go to Section 3.

Section 3: Using the Light Mixer

This section should be fairly easy. So let's get started.

Fire up your Wed program and open the `room.wmp` file in the reactor subfolder of the `LightTut` directory. You'll notice there isn't much to it. A couple of hanging lights, A 'cooling pool' with water, the reactor core hanging from a long yellow rod, and of course our old friend the wizard (that's you).

So go ahead and run the level, it should already be built. Your opening scene should look like this.



You are the Wizard, so go ahead and look around a little. We are using the standard `player_walk` template code to drive the wizard. **Arrow Keys to move, the mouse to look around and the Esc key to exit** is pretty much all you need. Careful, don't fall in the cooling pools. The wizard can swim, but the pools can be hard to get out of.

Oh, one more thing, **to move the reactor core you can press the w key for up and the s key for down. Press the a key to move the reactor towards the other end of the room and the d key to bring it back. Try it out.**

You'll notice that everything is pretty much grey. I'm not even sure dynamic lights can help this scene, but we'll try to spruce it up a little bit with the Light Mixer. **To access the mixer, simply press the p key now.** The Light Mixer Control panel should pop up.



I tried to make it look like a sound mixer board. I know, I know, all you artist types out there are going to tell me that this panel is ugly! Sorry, an artist I am not, but it works ok, and you are welcome to make your own later. In fact if you make a better looking one and don't mind sharing, send me a copy please!

You'll notice across the top of the panel there are headings like Material Emissive and Material Ambient with red, green, and blue slider knobs under each heading. These knobs raise and lower the values of our materials properties, such as emissive_red, and specular_blue. **To access the knobs we will need the game pointer, so press the right mouse button to activate it now.** You can click and drag to move the Material controls up and down, but they won't do anything yet, because we aren't attached to an entity.

Over in the right hand corner of the panel is a yellow arrow with the text " Entity Search" above it. **To select the next entity in the game, click on the yellow arrow. The text above the arrow should change to 'liftertube'. Click on the yellow arrow again and 'reactor1' should appear.** The reactor core (the spiked ball hanging from the yellow tube) is now our 'Target Entity'. Click on the small 'radio' button next to the word Transparent. Did the reactor core get transparent? If it did, that means that our 'Target' entity can be manipulated with the Light Mixer control panel.

Please note only entities that have ACTION code in the game's wdl file can be manipulated with the Light Mixer control panel.

Go ahead and press some more of the radio buttons and observe what they do. Some will cause the reactor to change others won't. We'll try to figure out why that is, in the next section.

Now that we know we can manipulate the reactor, let's attach to it. **To attach a material structure to an entity, simply click on the blue Attach button in the lower right.** When you do, the count above the button will go down by 1 to the number 3. This indicates we have 3 material structures left to attach to other entities.

Well there you have it. You can now slide the color knobs up and down, click on buttons and have fun trying to get different colors and lights out of our reactor. Some of the control knobs will seem to work, others won't seem to do a thing. No, the program isn't broken. You can try to figure out what's going on yourself, or you can go to the next section and I'll help you out a little. So have fun, and join me in the next section when you are ready.

Section 4 - Lighting Effects

The whole purpose of this tutorial is to get an understanding of how lighting effects work in A6. As I mentioned before, I was trying to adjust some things in a small demo game of mine, and got quite frustrated with it, because things weren't coming out right. At first I thought there was some sort of programming bug, because things that I thought should work, didn't. Then I thought it might be the A6 engine. And finally I came to the realization that the problem was me. I didn't understand what the manual was trying to tell me. So I built Light Mixer to help me figure out what was really going on. So let's get started and try a few things to help clarify the wonderful new features of A6 dynamic lighting. Things in **Blue** are actions that you need to take. Things in **Green** are important tips. If you don't want to get frustrated with this tutorial, **I would advise you not to move about the room at all unless instructed to do so.**

Start up the game

- 1) **press p to activate the Light Mixer Control Panel**
- 2) **press the right mouse button to activate the mouse pointer**
- 3) **click on the yellow arrow key in the upper right hand corner of the panel until you see 'reactor1'.**

We have now selected our target_entity to be the 'reactor'.

The first thing you need to know about entities in the game world, is that not all of them can have their lighting changed.

Only entities that have an ACTION assigned to them can be altered with the Light Mixer Control Panel. All other entities are 'read only'.

Read only entities show up in our text display, but we can't actually alter them. So, how do you tell the read_only's from the good ones. Well, programmatically I couldn't find a way (if I had, then I would have skipped over them). But you can tell. The easiest way to tell is to click on the Transparent radio button. Did the entity fade away to half visibility? If it did, then you can attach to it and alter it. If it didn't, then skip to the next entity. Actually, attaching to a read_only entity doesn't seem to hurt anything, it just wastes one of our precious materials structure.

Lesson 1: Entity Lighting Properties

All right, let's try to make some adjustments to our 'reactor1' entity.

Click on the yellow arrow until 'reactor1' appears.

To turn on and off the various lighting properties for an entity clicking on the radio buttons (such as transparent, flare, overlay, etc).

Try turning each one on and off separately while watching the reactor. Did you see the reactor change? Try them in combinations. **We are effecting the various target_entities lighting flags with these radio buttons, such as target_entity.metal = on;**

Some have a nice effect (like metal, flare and transparent). And some don't seem to do much at all, for example overlay.

GOLDEN RULE: The secret to whether or not the changes we make with the Light Mixer control panel have any effect totally depends on the existing light environment and even the entities color!

Overlay doesn't work on our reactor because 'overlay = on' means the black parts of the entities' texture (color RGB value below 8,8,8) will be transparent. Well, our gray reactor obviously must not have any colors below 8,8,8.

If you have moved the Wizard around in the room, then exit the game with the Esc key, and restart it (this way the wizard is in his starting position). Press the p key to raise the Light Mixer Control Panel, and click on the right mouse button to activate the mouse pointer.

Please don't move the wizard from his starting position for now. Just switch from first person mode by pressing F7 twice. Do you see the wizard facing you?

Click on the Yellow Arrow button until you see 'Wizard'. We have now selected the Wizard as our target entity.

Now click the overlay key on and off a few times. Did this him change? It should have. Now run down the entire list of radio buttons one at a time.



Do you like the metal option on the wizard? He looks like he is frozen in ice to me! Nice Effect!

Ok, with the wizard still facing the camera, turn off all of the radio buttons, and then click on transparency radio button. Did he fade to half visibility? Using the mouse pointer drag the Entity Alpha slider (the second white control button from the right) up and down. Did the Wizard fade in and out? This slider affects the target entity.alpha value.

Let's go back into 1st person mode, **so press the F7 key two more times.** The camera view should be facing the reactor again. **Press the Yellow Arrow key until you see 'Reactor1'.**

Now click on the 'Light' radio button. Did the reactor change at all? **This button affects the target_entity.light flag.**

Now click and drag the LightRange slider button (the third white slider button from the right) up and down and observe what happens. This slider effects the target_entity.lightrange value.

Let's try one more thing. **Set the lightrange of the reactor to zero.** Now, see the red, green and blue slider buttons under the Entity heading. **Try moving the red entity slider all the way up, and all the way down.** What Happens? Did the reactor color change? **These sliders affect the target_entity.red/green/blue values.** **Now raise the reactors lightrange up to 500. Try moving the red, green and blue sliders any way you like.** What changed colors this time, the reactor, the walls, or both?

Ok, that's enough about the entity lighting effects. Did everything work for you? If not, go to the manual and read up on the subject. See if you can figure out what you are going to need to do to make it work. Play around with the different lighting effects options using the Light Mixer control panel. Have fun! Next up: Materials:

Lesson 2: Attaching and using a Material Stucuture

It's time to use the rest of our panel and play with some of the material structure options. Let's start fresh, so we are in sync. **Please exit the reactor game if you have it running and then start it back up gain.** Press the p key to raise the panel, and right click to turn on the mouse pointer.

Let's see if we can fix up our scene to more of what I described on the opening page. Select the reactor as our target entity. **Click on the yellow arrow until you see 'Reactor1'.**

Now lets try using the materials structure to manipulate our reactor. **To attach a material structure to our target entity, click on the blue button labeled Attach.** Did the reactor change? It shouldn't have. The counter just above the attach button should now read 3. This indicates we have 3 more materials left that we can attach to other entities.

Lesson 3: Setting Material.Diffuse_Red/Green/Blue

Diffuse means the material's surface will appear darker or brighter, depending on its angle to sun, or dynamic lights.

On the Light Mixer control panel under the heading Material diffuse, lower the red slider down slowly and watch what happens to the reactor. Now do the same thing with the green slider and then the blue. Did you end up with a totally dull black reactor?

Try moving the diffuse sliders to different positions and watch the results.



When you are done, please set the diffuse sliders so that there values read as follows: diffuse = 255,135,1. When you see this in the future read it as: diffuse_red = 255, diffuse_green = 135, and diffuse blue = 1. This setting should give the reactor a 'dark golden' appearance.

Lesson 4: Setting Material.Specular_Red/Green/Blue

Specular refers to specular highlights, i.e. having the quality of metal. In fact, when you set an entities metal flag, this the specular lighting is what is adjusted. Specular highlights depend on the camera direction.

Press the x key to stop the rotation of the reactor. Set specular = 1,1,1 if it isn't already. Walk around the reactor and observe. Now set specular = 255,135,1. Walk around the reactor and observe the difference. If you are used to steering with the mouse, you can press the right mouse button to toggle the mouse pointer on and off.

Does it have a metal look to it now? Press the x key again to start the reactor rotation. Play around with both the diffuse settings and specular settings and see what else you can come up with.



When you are done set: diffuse = 255,135,1 specular = 255,135,1
 This should give our reactor a 'yellow-golden-metallic' appearance.

Lesson 5: Setting Material.Ambient_Red/Green/Blue

From the manual: ambient_red/green/blue influence the entity and camera ambient parameters, the entity red, green, and blue parameters if it is self-lit, and the level lighting by static light sources at the floor below the entity. In the glossary I found, ambient is a light and material property that illuminates all parts of an object equally, regardless of their orientation, position, and surface characteristics.

Well this one has me a little confused. Let's play around a little and see if we can make some sense of it. **Let's set ambient = 1,1,1.** Did the reactor change? Why not? **Try setting ambient_red = 255 and leave the others alone.** Still no change? What could the problem be? Is my program broke? Does the A6 engine have a problem? Maybe it's my graphics card messing up, or the graphics driver, or...Before you go to the forum to file an engine bug hunt, remember our Golden Rule. Something else in the game environments lighting or the entities color may be preventing us from changing ambient_red/green/blue.

The manual mentioned STATIC lighting. The overhead lights in the reactor room are DYNAMIC. Could this be it? Well fortunately I remember that I stuck a static light over the cooling pool at the other end of the room. **Press the a key to move the reactor down to the other end of the room. Walk along behind it and observe.** Don't let it get too far ahead of you. Hey did you see that! When we got down to this end it starts showing some red color. My program works fine! It was just the fact that dynamic lights don't influence ambient settings. We needed a static light to see the change! Ok, your turn. While you are at this end of the room play around with static lights and see what you can come up with.

When you are done set: ambient = 255,135,1 diffuse = 255,135,1 specular = 255,135,1 and press the d key to bring the reactor back under the Dynamic Light fixtures.

Now we should have a yellow-golden-metallic appearance at both ends of the room.

Lesson 5: Setting Material.emissive_Red/Green/Blue

From the manual: Color that is emitted by the material itself, and adds to the entity lighting.

Ok, that seems to be straight forward. Lets try it. **Set emissive_red = 255.** Did you get a redish glow towards the bottom of the reactor.



Cool! That was easy enough.

The manual says that it adds to the ENTITY lighting. So this red is added to our reactors own light? Well let's find out.

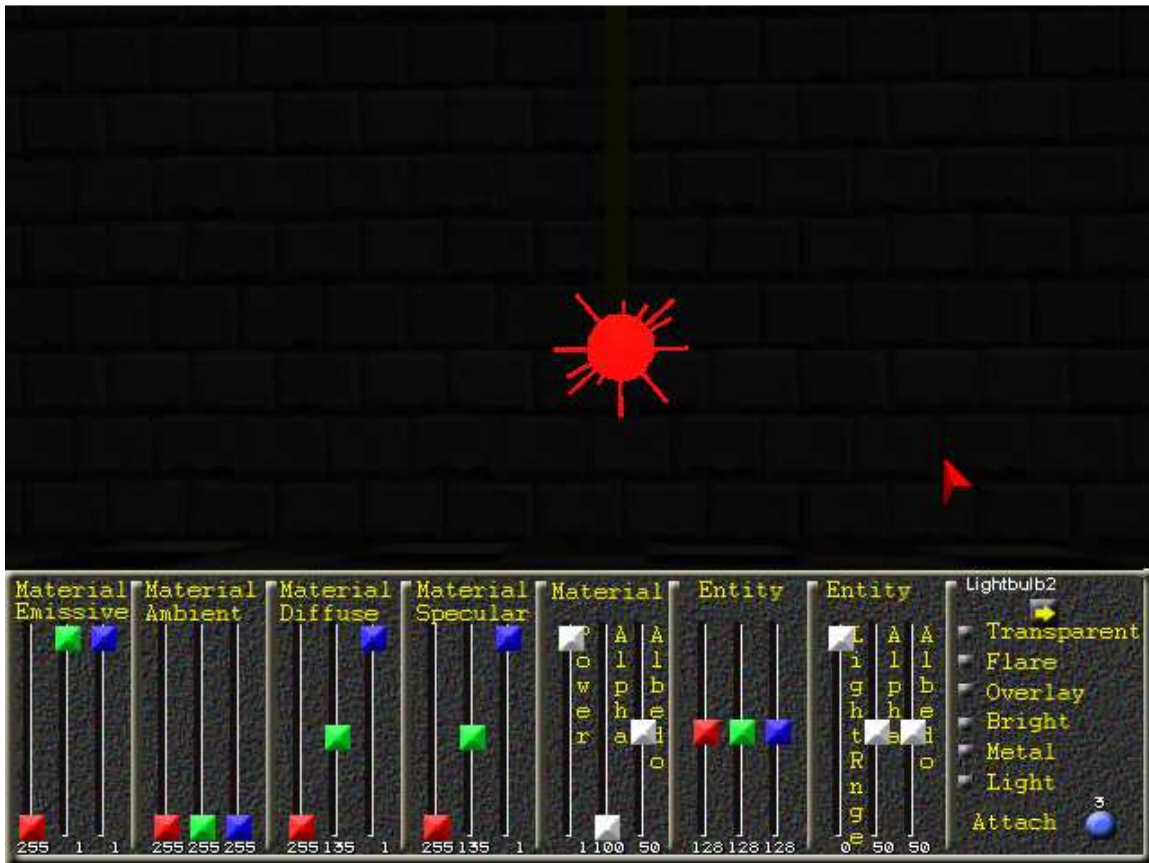
Lesson 6: Working in the Dark

Let's turn those lights off and see what our reactor looks like in the dark. Remember that I said the light fixtures contained dynamic lights. That means we can turn them down to see what our entity looks like on it's own lighting.

Click on the yellow arrow until you see 'lightbulb1'. Click and drag the entity lightrange for 'lightbulb1' to 0.

Did the room lighting go down? Now we can try the other light fixture.

Click the yellow arrow until you see 'lightbulb2'. Click and drag the entity lightrange for 'lightbulb2' to 0.



Did the room light go down almost black? Does the reactor now look red? It should.

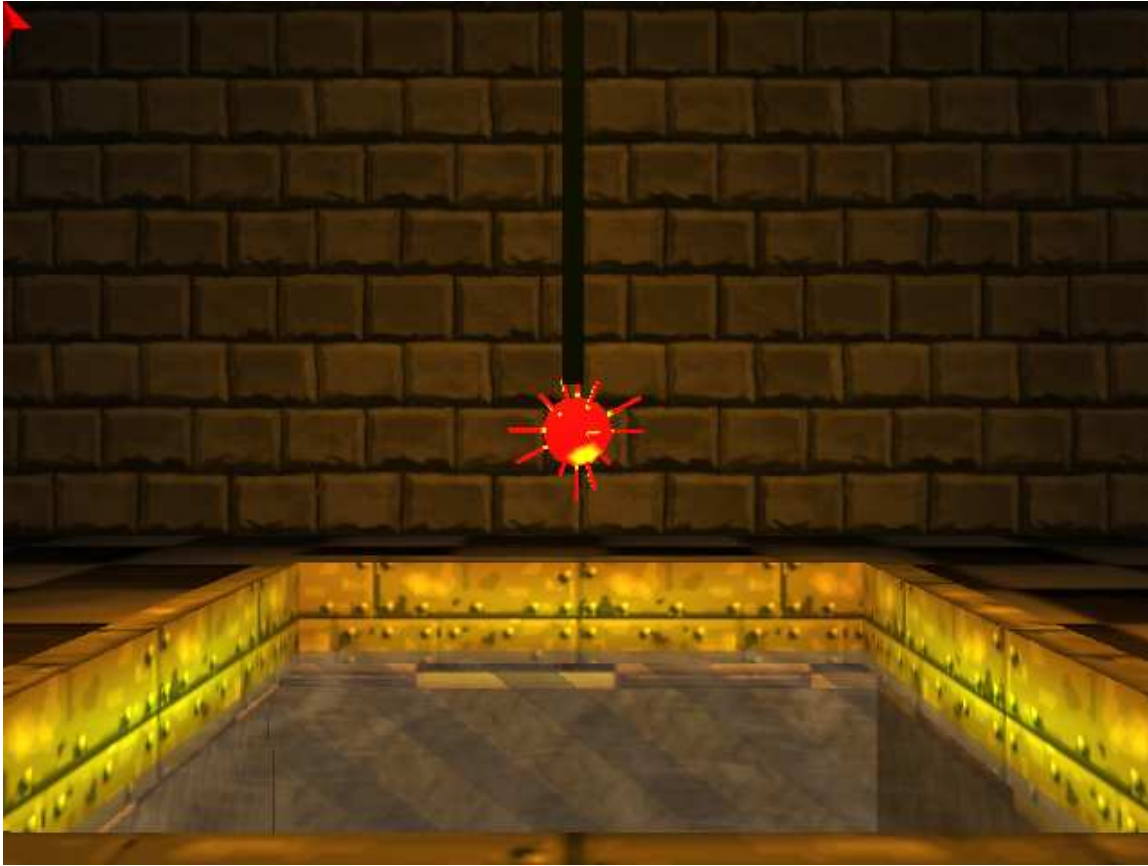
Now let's adjust the entities lighting a little and see what happens. Click on the yellow arrow until you see 'reactor1'. If you have the sound on, you should have heard a beep to indicate that we already have a material attached. Set the ENTITY red, green and blue sliders to 135,135,135. These sliders affect the light that the reactor emits.

Look down at the cooling pool (with the mouse pointer active you can still look down by pressing the page down key). You should be able to see the pool water but that's about it. Set the lightrange for reactor1 up to somewhere around 250. Notice that the cooling pool underneath the reactor is now lit up with a white light and we can see some of the tiles and the wall. Look back up at the entity. Does it a little more look like it's a hot reactor?



The reactor light now illuminates the cooling pool, tiles and walls.

While looking down at the cooling pool, slowly lower the entities color BLUE down to 1. Notice the change in the overall lighting of the pool, tiles to a more greenish white. Now slowly lower the entities Color green down to 75. Press p again to lower the Light Mixer Control Panel.



Notice that we now have a burning orange color on the cooling pool and tiles. Remember this is the light being emitted by our reactor. To prove it to yourself, lower the reactor down into the pool of water until you hear a beep. **Lower the reactor with the s key.** Then slowly raise it back up. **Raise the reactor with the w key.** So what do you think. Does this give you the feel of a hot reactor?

Well at least it looks a lot better than the ugly grey thing we started with. Ok, play around on your own and see what you can come up with.

Lesson 7: Learning on your own

You've got the tools, you've got the time, so figure the next three out on your own. Read each of these manual descriptions over carefully and see if there are any clues on how to use them.

From the manual: Material.power: Sharpness of specular highlights. To turn off specular highlights for a material, this parameter should be set at 0.

From the manual: Material.alpha Opacity of the material, 0..100. Is normally overridden by the entity's alpha value, except for shadows.

From the manual: Material.albedo: Determines the influence of the sun light. If at 0, the material does not reflect sun light at all. Above 0 the amount of sunlight reflection depends on the brightness of the shadow map below the entity. At 100 the sunlight is reflected fully regardless of the shadow map.

P.S. I couldn't get material.alpha to do anything in the reactor game, but remember our golden rule. I suspect I am missing something in the game that material.alpha would have an effect on. Again, read the description over carefully for clues.

Lighting Effects summary

Well, I hope I've given you some ideas of what you can do with the Light Mixer to tune up your games dynamic lighting effects! **Remember the golden rule with lighting effects, the lighting environment in your game and the colors of the entities all work together to give you your lighting.**

Play around with the Light Mixer in the reactor room and see what other interesting things you can do. Here's a couple of things to try.

- 1) Fix the lightbulbs in the two fixtures so they actually look like florescent light bulbs.
- 2) Or, if you want, punch a hole in the wall with WED, add some sky and ground, move the reactor core out on the lawn, and see how the sun effects it!

Remember this as well. We didn't actually change anything in the game at all. When you exit, the things we tweaked go back to the way they were. So if you really like an effect be sure to write down the settings. Then code up the material and entity options in your game yourself. Hey, here's an idea. Why don't we add the ability for Light Mixer to generate the material and entity settings with the click of a button! Oh, if only I had more time. Or, if you can't wait, you've got the code, so start coding!

Next Up: Using the light mixer in YOUR game.

Section 5. Using Light Mixer in *your* Games

This section should be really short. Putting the Light Mixer control panel in your own C-Script program is very easy. Here is what you need to do step by step. I'll cover all the steps here although you should already have done step 1.

1 From the file lightmx.zip, unzip the lgthmxr directory into your A6 game directory (usually C:\\Program Files\\GStudio6).

2. To use with a game you are developing, add the following lines of code into the games main wdl file of your game.

```
/*  
The following two lines are required to use the Light Mixer Control Panel in any game  
*/
```

```
path "C:\\Program Files\\GStudio6\\lightTut\\lgthmxr"; // Path to WDL templates  
subdirectory  
include <lmx.wdl>; // Light Effects Panel
```

3. If your main development area isn't C:\\Program Files\\GStudio6 then change the path line in the above code to match where you put the lgthmxr directory.

That's it. I told you it would be easy. I've only got a couple of small games that I've tested Light Mixer with, so I can't claim that it will work perfectly with everything. However, you've got the source code! So you can fix up any problems you might encounter yourself!

KNOWN CONFLICTS:

1) I use the on_p command to assign the letter p to toggle the Light Mixer Control Panel. If your game uses the letter p, then you need to change lmx.wdl to use some other key that you are not using to toggle the panel.