So what do uranium, fluorescence, and some flashy yellow pieces of thrift store glass have in common? They all add up to form a unique and magical looking product known as Uranium Glass. While the next page explains the origins of the use of Uranium as a glass colorant, lets use this page to review what fluorescence is, and what causes it!

URANIUM, fluorescence, AND THAT CRAZY YELLOW GLASS!!!

Fluorescence, as described by Kurt Nassau, is the instantaneous production of light when a substance is exposed to any type of radiation. The type of radiation we are concerned with here is the high energy **ultraviolet radiation ,** which on the electromagnetic spectrum has a higher frequency than the visible spectrum of light, and a lower frequency than harmful X-rays.

The range of the visible spectrum allows us to perceive light and color, and thus, the objects and materials all around us. Although high frequency of ultraviolet (**UV**) waves are not perceptible to the human eye,they are capable of causing reactions which we can see. One example of this is fluorescence. If you can recall the way a neon sign works, you know that atoms of neon (gas) give off red light when an electrical current is applied to them. This is because the current causes the neon's electrons to become momentarily excited, rising to a higher orbital. As the electron falls back to its original orbital, the energy difference between the two states is emitted as light. Now we can substitute neon for another element-- Uranium, and instead of an electrical current we can apply high energy UV light rays. Because of their high frequencies the UV rays act upon the uranium atoms much as electricity did on the neon atoms: the uranium's electrons are excited to a higher orbital state momentarily, and dropping back down release energy in the form of a light which falls within the visible spectrum.

So now, the question is where does this UV light come from, and how do we get some to shine on the uranium so it fluoresces? UV light is a natural part of the electromagnetic spectrum. Sunlight contains significant amounts of UV light. Much of it is filtered out of the earth's atmosphere by the ozone, but the amount which reaches us is still enough to be problematic if we aren't careful! Remember how those high frequency UV rays penetrated the uranium atom and excited the electrons? Its high frequency also allows the UV to enter our cells and cause damage to them over time.

Fluorescent lamps utilize UV rays to produce visible light. The gases in the fluorescent tube, excited through the addition of electricity, release UV rays which are absorbed by a thin phosphor coating inside the tube. The phosphors, in turn, become excited and release a lower frequency of energy, which falls within the safe range of visible light. In special cases, the coating of phosphors may be replaced by a filter which absorbs all frequencies *except* the UV- - this is a UV light source, often called a "black light".
The black light fixture emits sufficient amounts of UV radiation to trigger the fluorescence in uranium!

URANIUM GLASS

During the early 19th century glass makers in Central Europe started to use uranium as a good way to make yellow and green glass. In 1789 **Martin Klaproth** in Germany had first recognized uranium as a chemical element, and is said to have added it to glass as a colorant. But it was 50 years later that glassmakers in Bohemia, seeking new colors in a highly competitive market for glass, started to use uranium on a large scale.

Perhaps the most striking thing about uranium glass is that it is radioactive. If you apply a geiger counter you will get a positive reading, but the levels are not, so far as is commonly believed, in any way harmful. Two pounds of uranium oxide were typically added to around 184 pounds of other glassmaking constituents. If you shine a UV light onto a piece of uranium glass, you will get a fluorescent green glow typical to uranium ore specimens. The artist Sigmar Polke is an avid collector of uranium glass!

When added to the glass mixture, usually as an oxide, uranium produces colors varying from amber through all the shades of yellow, to bright apple green, depending on the glass mixture. When added to a glass mixture with a very high lead content (over 70% lead oxide) it produces a deep red color.

Josef Reidel is usually credited with inventing uranium glass in 1830 under the names "Annagrun" for uranium yellowish- green glass, and "Annagelb" for uranium yellow glass, naming them after his wife Anna Maria. During this early period, uranium glass was normally heavy colored crystal glass with beautiful facet cutting and polishing. It was also sometimes decorated with enamel or engraved. When pressed glass became popular later in the century, uranium was often used to make green and yellow shades by factories all over the world, including the US and England.

In the 1940's it was banned as a glass constituent because uranium was used to make the atom bomb, there were fears for the health of glassworkers, and both US and UK Governments wanted to restrict access to uranium for military reasons. The British Government even confiscated large quantities of glass-making materials which had uranium in them just after the war.

During the 1950's these restrictions were lifted and some companies now use uranium as a colorant occasionally. However there are other chemicals which can now be used to produce the same colors, and the price of uranium oxide is high, so there is not likely to be a resurgence of popularity for uranium glass manufacturing. There are also rigorous control regulations covering protective clothing for workers, lead shielding for storage areas, and monitoring of radiation. Small amounts have been made, usually small items and usually made for collectors. Boyd Glass and Fenton Art Glass are two USA companies that produce uranium glass items today.

Real teeth have natural **fluorescence**. If you shine a black light on them they glow a brilliant white. To give dental work the same glow, the use of **uranium** in dental porcelain was patented in 1942.

The timing of this was suspicious. You have to wonder if those Manhattan Project scientists, toiling over crucibles of hot uranium, got to thinking, hey, if this atom-bomb thing flops, we can always go into teeth.

The glow imparted to false teeth by uranium was not a consequence of radioactivity. Uranium merely happens to fluoresce in the presence of UV light. Fluorescence is harmless; lots of compounds do it. Uranium's advantage was that it would survive the high heat of porcelain manufacture.

Still, you did have the problem that uranium was radioactive. In the wake of Hiroshima and Nagasaki it occurred to the dental-ceramics industry that a substance that had destroyed cities might not be such a good thing to use in somebody's mouth. Manufacturers discussed the situation with the Atomic Energy Commission in the 1950s. The debate proceeded along the following lines. On the one hand, putting uranium in people's mouths might possibly give them cancer and kill them. On the other hand, their teeth looked great. It was an easy call. The industry was given a federal exemption to continue using uranium.

In the 1970s some began to wonder if this had been the world's smartest decision. The amount of uranium used in dental porcelain was small--0.05 percent by weight in the U.S., 0.1 percent in Germany. Nonetheless the fake teeth bombarded the oral mucosa with radiation that was maybe eight times higher than normal background radiation. None of the research I came across mentioned a specific number of cancer deaths, but clearly this was not something you'd do for the health benefits.

There was also the unavoidable fact that the aesthetic gains achieved using uranium were slight. To see the teeth fluoresce you needed UV light, and, as one study sniffily noted, "UV lamps are used mainly in some discotheques and restaurants" frequented by "only a very small fraction of the population with these types of restorations."

But come on, you're thinking. If even one guy with fake teeth looked good in a disco, wasn't that worth a little risk?

Even that advantage turned out to be illusory, however. Though it was claimed that the best uranium compounds replicated the white fluorescence of natural teeth, research showed that some porcelain teeth fluoresced red, violet, or bright yellow. In other words, not only were you nuking your gums, when you opened your mouth you looked like a neon sign.

That put the matter over the top. Numerous authorities urged that the use of uranium in dental porcelain be discontinued, and in the mid-1980s the federal exemption was revoked. Most dental porcelain sold today is uranium-free.

From Cecil Adams' "The Straight Dope"