South Pasadena • Chemistry

Name _____
Period ___ Date ___/___/___

Unit 6—What Does the Nucleus Look Like?

USES OF RADIOACTIVITY

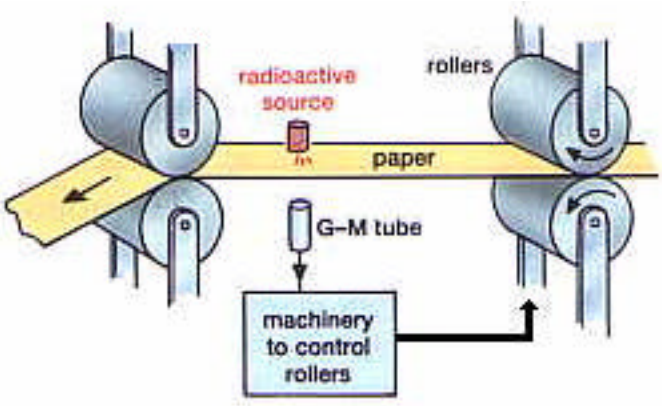
Smoke Detectors

Smoke alarms contain a weak source made of Americium-241.

Alpha particles are emitted from here, which ionize the air, so that the air conducts electricity and a small current flows.

If smoke enters the alarm, this absorbs the a particles, the current reduces, and the alarm sounds.

Am-241 has a half-life of 460 years.



Thickness Control

In paper mills, the thickness of the paper can be controlled by measuring how much beta radiation passes through the paper to a Geiger counter.

The counter controls the pressure of the rollers to give the correct thickness.

With paper, or plastic, or aluminum foil, β rays are used, because α will not go through the paper.

We choose a source with a long half-life so that it does not need to be replaced often.

Sterilizing

Even after it has been packaged, gamma rays can be used to kill bacteria, mold and insects in food.

This process prolongs the shelf-life of the food, but sometimes changes the taste.

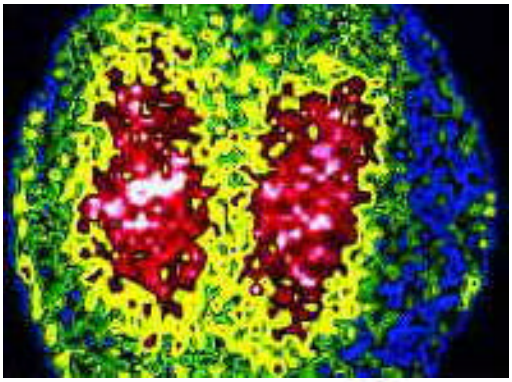
Gamma rays are also used to sterilize hospital equipment, especially plastic syringes that would be damaged if heated

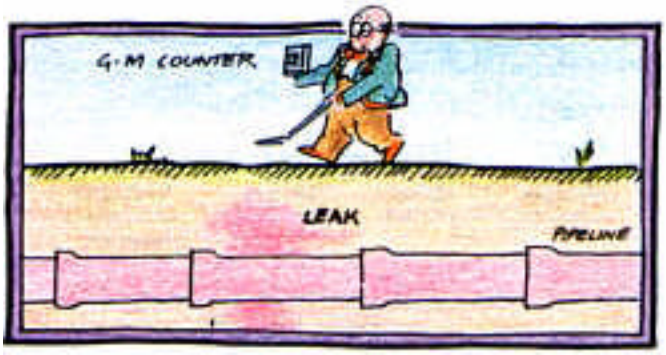
Radioactive Dating

Animals and plants have a known proportion of Carbon-14 (a radioisotope of Carbon) in their tissues.

When they die they stop taking Carbon in, then the amount of Carbon-14 goes down at a known rate (Carbon-14 has a half-life of 5700 years).

The age of the ancient organic materials can be found by measuring the amount of Carbon-14 that is left.





Radioactive Tracers

The most common tracer is called Technetium-99 and is very safe because it only emits gamma rays and doesn't cause much ionization.

Radioisotopes can be used for medical purposes, such as checking for a blocked kidney.
To do this a small amount of Iodine-123 is injected into the patient, after 5 minutes 2 Geiger counters are placed over the kidneys.

Also radioisotopes are used in industry, to detect leaking pipes. To do this, a small amount is injected into the pipe. It is then detected with a GM counter above ground.

Checking Welds

If a gamma source is placed on one side of the welded metal, and a photographic film on the other side, weak points or air bubbles will show up on the film, like an X-ray.

Cancer Treatment

Because Gamma rays can kill living cells, they are used to kill cancer cells without having to resort to difficult surgery. This is called "Radiotherapy" and works because cancer cells can't repair themselves when damaged by gamma rays, as healthy cells can.

It's vital to get the dose correct - too much and you'll damage too many healthy cells, too little and you won't stop the cancer from spreading in time.

Some cancers are easier to treat with radiotherapy than others - it's not too difficult to aim gamma rays at a breast tumor, but for lung cancer it's much harder to avoid damaging healthy cells. Also, lungs are more easily damaged by gamma rays, therefore other treatments may be used.

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