

Application 1: Counterfeit Money

How much money do you think the Bank of Canada puts into circulation each year?

Answer: 1.4 billion bills - worth \$38 billion dollars.

Counterfeiters used to make copies of Canadian \$100 bills, but stopped in the 1990's because retailers stopped accepting any and all bills over \$50 (some still don't accept them). Counterfeiters now make counterfeit money using \$10 bills.

The Bank of Canada constantly develops currency with security features that make it difficult to counterfeit.

Money (\$20, \$50 and \$100 bills) is made with planchettes (small, oval, removable green paper disks that are coated with UV fluorescent ink) that are added to the pulp while making the paper. The planchettes are removed after the paper is made, however, the fluorescent ink is engrained in the paper. Counterfeit bills are surface painted - so there is no way to make the ink UV fluorescent (ie., glow when put under UV light).



When the fluorescent ink of genuine Canadian money is put under UV light the electrons absorb energy and enter the excited state. Upon returning to ground state, the electrons release energy as fluorescence.

A genuine Canadian bill will fluoresce at random points when put under a UV light.

SCH 4C

J. Kropac

What about \$5 and \$10 bills?

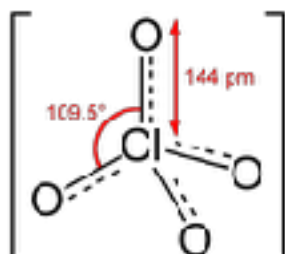
- These bills are made with blue and white fibers. Under UV light - the blue fibers appear blue
- But the white fibers appear red.
- The sections that fluoresce are the amount of the bill, coat of arms, and "Bank of Canada"

Application 2: Fireworks

Fireworks contain different metals that produce different colours of light.

Based on the flame test lab, what metals are present in the following fireworks?

| Metal | Sodium | Potassium | Calcium | Copper | Strontium OR Lithium |
|--------|--------|-----------|---------|--------|----------------------------|
| Colour | Yellow | Purple | Orange | Blue | Red |



What makes fireworks "go off"?

- an oxidizer (a chemical with a lot of oxygen that results in an explosion with certain elements)
- Examples of oxidizers: nitrates, chlorates and perchlorates

Barium nitrate and potassium perchlorate are two compounds found in fireworks
The problem?

- Perchlorate and barium both get into ground water and soil
- Perchlorate - effects thyroid gland in humans and causes growth abnormalities in embryos
- Barium - interferes with heart function and constricts air passages to impair breathing

HOW FIREWORKS WORK: Chemistry in Action!

This 4th of July, as you hear the bangs of fireworks and see the showers of colors coming down, know that you are seeing chemistry in action!

The shell holds gun powder; tiny pieces of metal, stars that produce the color and binding paste to keep it all together.

These bits of metal oxidize (chemically combine with oxygen), heat up and begin to sparkle.

When the fuse hits the gun powder in the shell, it blasts the oxidizing metal outward, creating fireworks.

The firework's color is determined by chemicals mixed with the metal.

- BLUE - Strontium
- YELLOW - Sodium
- RED - Strontium
- GREEN - Barium

Other metals and combinations of metals can produce other colors.

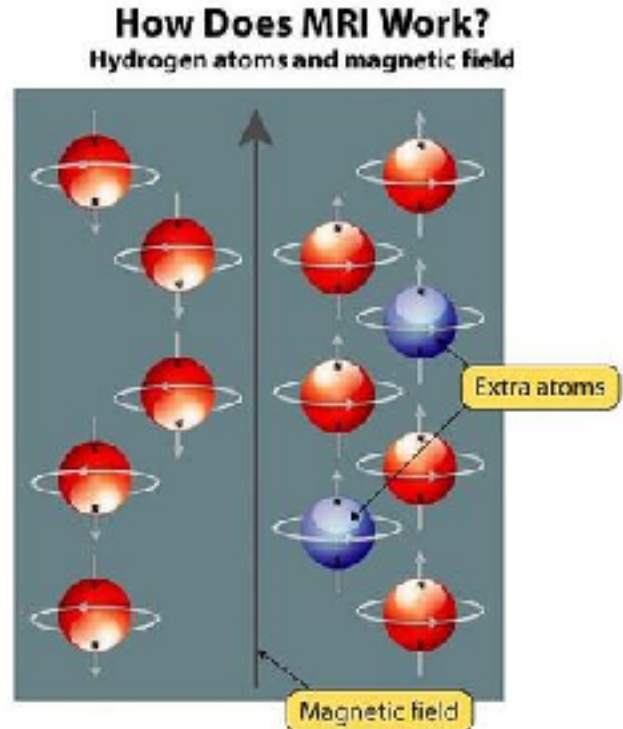
Always use fireworks and sparklers under adult supervision and in accordance with state law.

CHILDREN'S MUSEUM
MORTAR

<https://www.childrensmuseum.org/learn/activities/4th-of-july-fireworks-worksheets>
<https://www.childrensmuseum.org/learn/activities/4th-of-july-fireworks-worksheets>
<https://www.childrensmuseum.org/learn/activities/4th-of-july-fireworks-worksheets>

Application 3: MRIs

- When the MRI machine is turned on, your body is subjected to a strong magnetic field
 - our bodies contain billions of hydrogen atoms
1. The protons in the hydrogen atoms of our bodies align with the north and south poles on the magnet of the MRI machine
 2. radio wave energy is then applied to the hydrogen atoms which absorb the energy and spin
 3. Stopping the radio waves causes the hydrogen atoms to release the energy. This energy is detected and turned into a detailed image that can detect cancer and other abnormalities



In MRI atoms align with the magnetic field. For every two million hydrogen atoms there are nine more aligned with the magnetic field.