Colour and Chemistry: Applications in Daily Life

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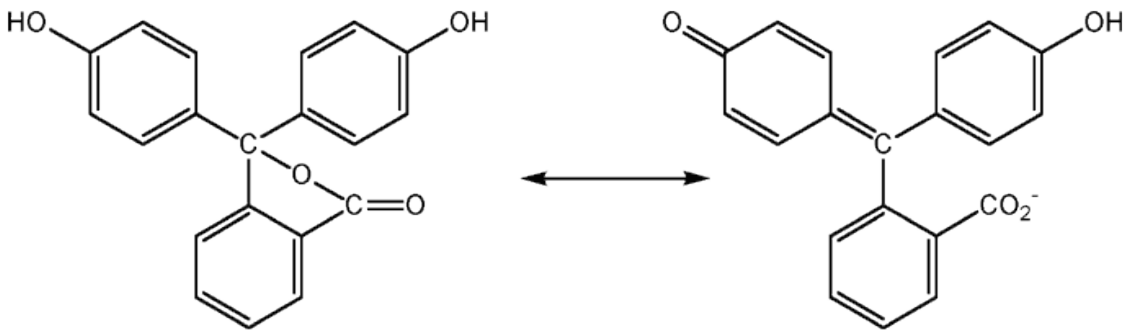
Chemical Indicators

Any substance that gives a visible sign, usually by a colour change, of the presence or absence of a threshold concentration of a chemical species.

Example: Acid-Base Indicators Phenolpthalein

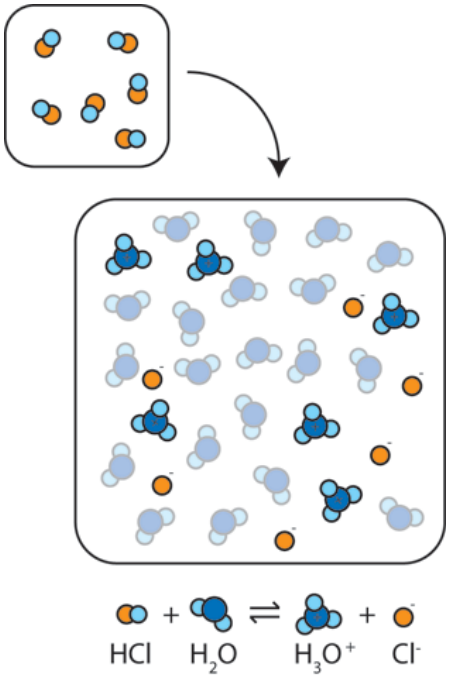
Water to Wine



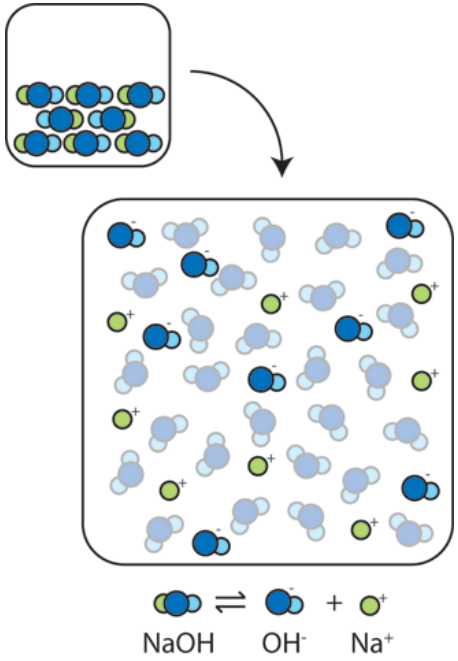
Acidic: Colorless **Basic: Pink**

Acid, Base and pH in a nutshell

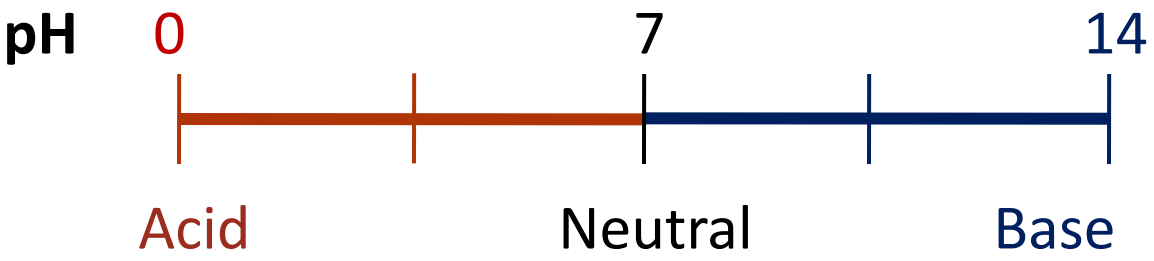
Acids



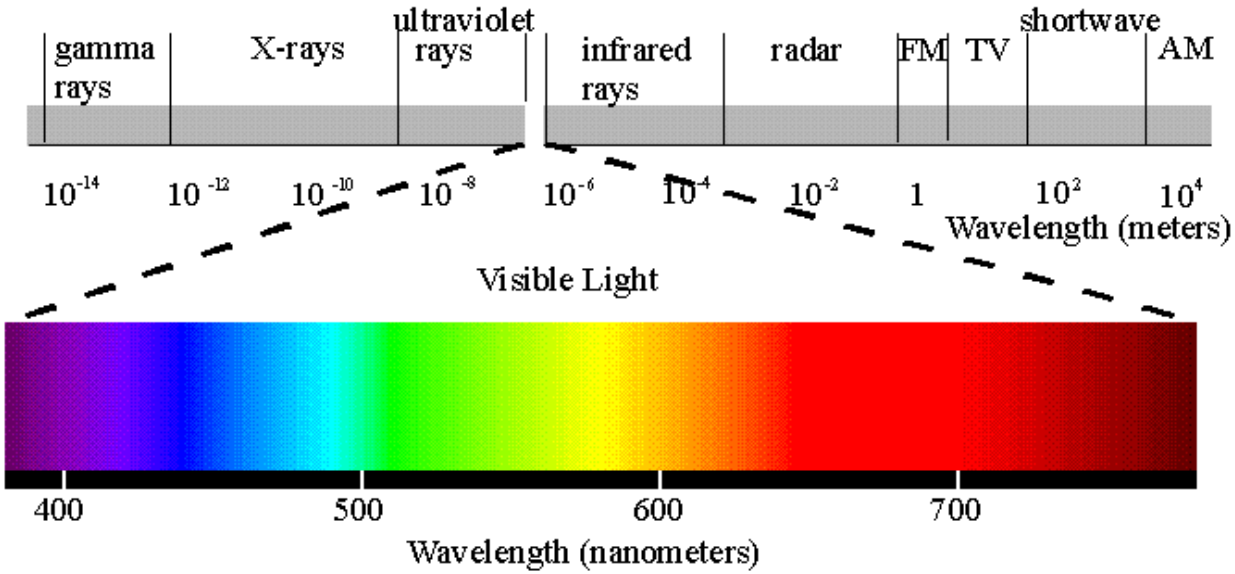
Bases



pH is a measure of the concentration of H^+ ions in a solution

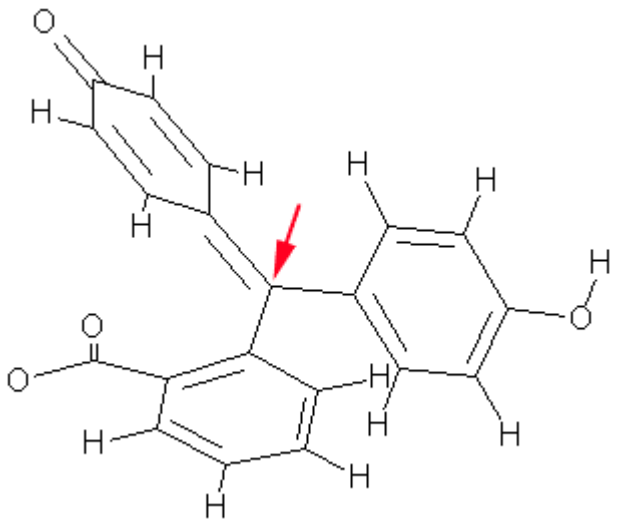


Color and Molecular Structure

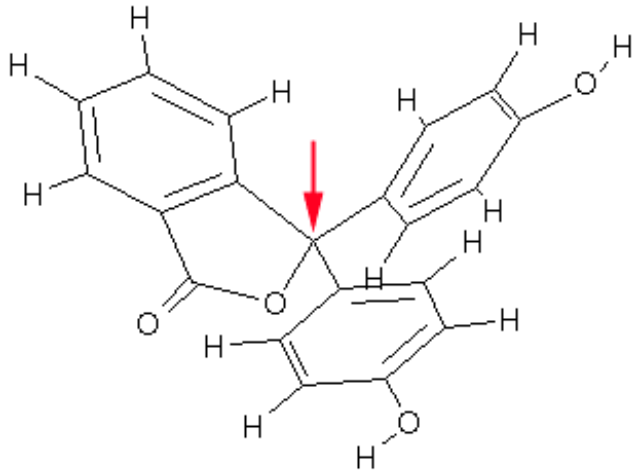


- Light delivers energy in little packets called photons
- Different colors of light pack different amounts of energy in their photons
- All materials absorb photons of some energy. But only substances that absorb photons of visible light will have color
- Different molecules absorb different colors of light, depending on their electronic structure

Mystery behind “Water to Wine”



In Base



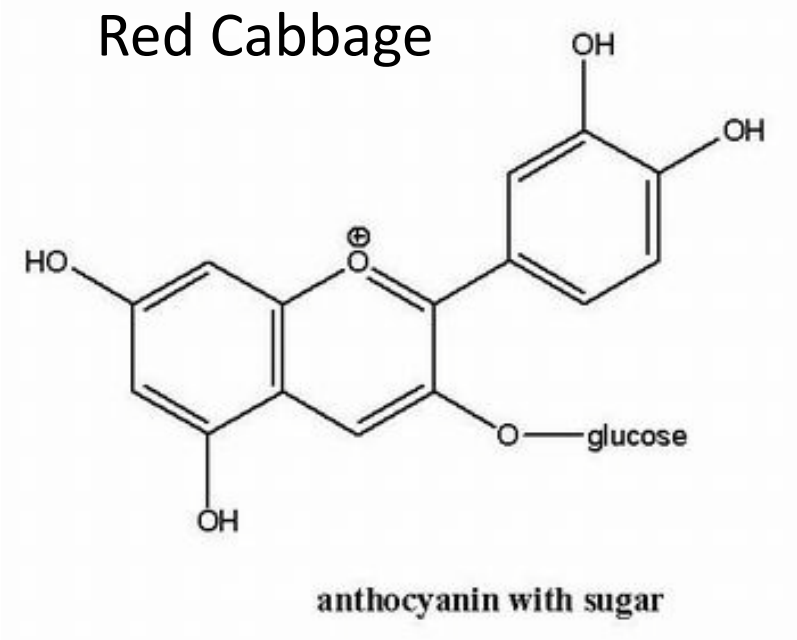
In Acid

Molecule flat: electron moves freely over most of molecular framework

Molecule not flat: electron does not move freely and absorbs in the UV

Red Cabbage: Natural Indicator

Red Cabbage



anthocyanin with sugar

pH	Color
2.1	red
3.6	red-violet
5.9	violet
7.0	blue-violet
7.4	blue
9.8	blue-green
> 12	green

Natural pH sensitive indicator

Mood Lipsticks

Product Description: Colour changes instantly according to body chemistry - Long lasting 12 hour lip colour - Moisturizes and protects with ALOE VERA and antioxidants Vitamins A, C & E

Methylene Blue: Redox Indicator

Methylene Blue

Leucomethylene Blue

Reduction ⟶

⟵ Oxidation

Blue

Colorless

Solution contain Glucose, Methylene Blue and Sodium Hydroxide

Reaction 1

Methylene Blue + Glucose ⟶ Leucomethylene Blue + Sodium Gluconate

Reaction 2

Leucomethylene Blue + O_2 ⟶ Methylene Blue + H_2O

Methylene Blue as Oxygen Indicator

- Presence of oxygen necessary for re-oxidation

- If vial is not opened after each experiment to let in sufficient oxygen, the re-oxidation to methylene blue doesnot work

- Can be used to determine the presence of oxygen in certain samples

Methylene Blue as indicator for testing milk quality

Milk → Pasteurized (does not contain microorganisms)

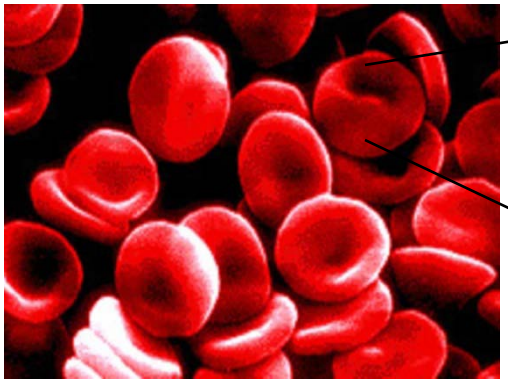
Milk → Unpasteurized (contain bacteria such as *lactobacillus sp*)

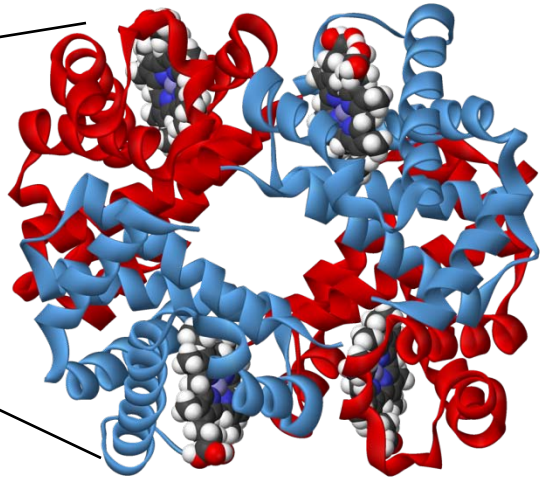
Pasteurized Milk + Methylene Blue → Remains Blue

Unpasteurized Milk + Methylene Blue → Slowly turns colorless

Indicators here, there, everywhere

Indicators to Detect Blood in Crime Scene





Haemoglobin + H_2O_2 ⟶ ½ O_2

Reduced Phenolpthalein: Colorless

Oxidized Phenolpthalein in Base: Pink

The Composition of Paint

Paint is composed of colored pigment and a binder

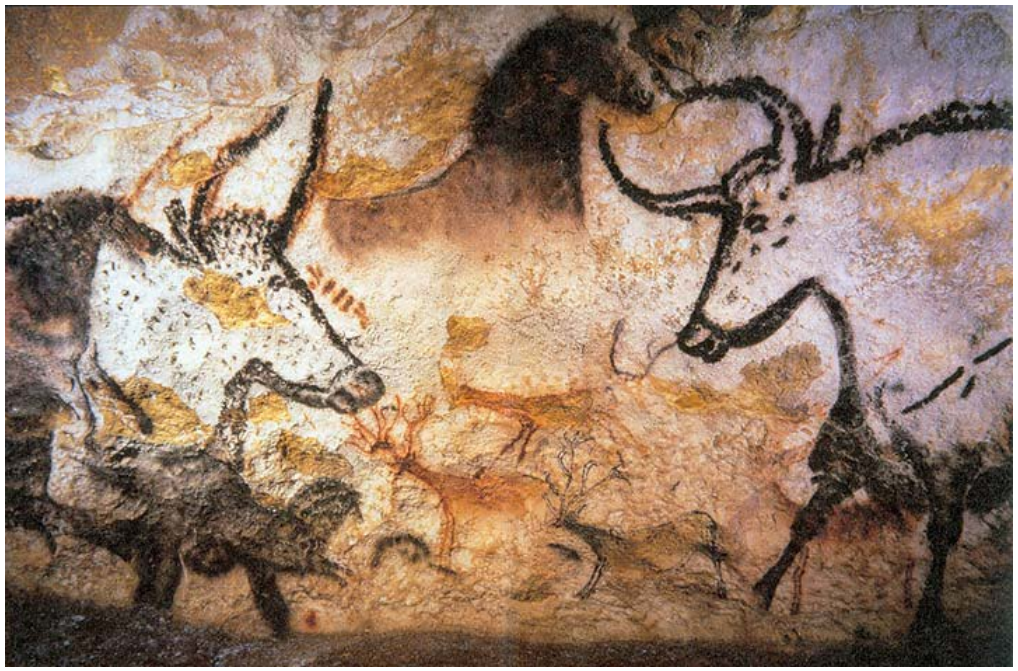
Pigment: Colored powdered substance (minerals, inorganic salts, dyes)

Binder: Material that evenly disperses the pigment, adheres to surface when paint applied and then dries

Additives: Such as Glycerine for brushability, antioxidants to prevent paint spoliage

Paints are homogeneous mixtures, are uniform throughout

Brief but Colorful History of Paint



Bison

- Dated 35,000 years ago
- Painted in cave walls by the Cro-Magnon man , our Paleolithic ancestors
- Found in Lascaux, France

Pigment

Binder

Saliva and animal fat

Earth's Natural Palette

Red

Hematite: Iron Oxide

Cinnabar: Contains mercury; toxic

Blue

Lazurite: Bright blue; very expensive

Azurite: Blue with green tinge; basic copper carbonate much cheaper; used by Michelangelo

Earth's Natural Palette

Yellow and Orange

Orpiment and Realgar: used as late till 19th century when it was discovered to have arsenic.

Van Gogh's mental illness and Monet's blindness were probably caused by it

Green

Malachite is a copper compound and is possibly the oldest known green pigment used.

Inorganic Salts as Pigments

Colored Pigments can be formed by precipitation of aqueous ions in solution

Yellow lead chromate

$$Pb(NO_3)_2 + Na_2CrO_4 \longrightarrow PbCrO_4 + 2NaNO_3$$

White zinc hydroxide

$$Zn(NO_3)_2 + NaOH \longrightarrow Zn(OH)_2 + 2NaNO_3$$

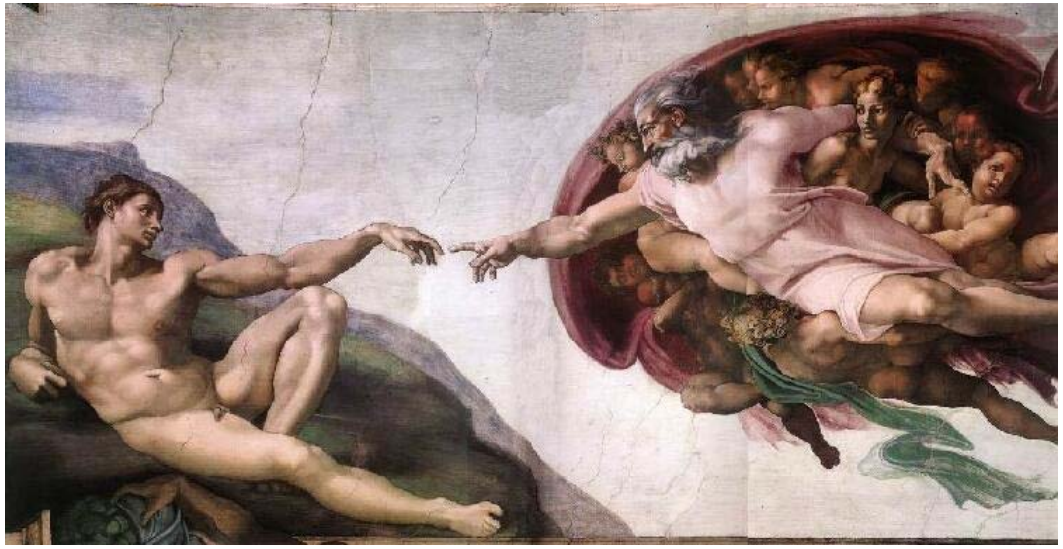
Blue Copper Carbonate

$$Cu(NO_3)_2 + Na_2CO_3 \longrightarrow CuCO_3 + 2NaNO_3$$

The Frescos

Ceiling of Sistine Chapel, Vatican City

Michelangelo: Created the most influential works in Fresco in the western art history



Creation of Adam

Painting of Fresco's and Secco's: Egg Tempera

- They were done mostly using egg tempera paint
- It contains a colored pigment and the yolk of an egg mixed with water
- The egg temperas were absorbed into freshly spread wet plaster and remained vibrant as long as the paint survived
- The paint became part of the plaster

Making Binder for Egg Tempera

The egg yolk will now be mixed with equal amount of water to make the binder

The pigment

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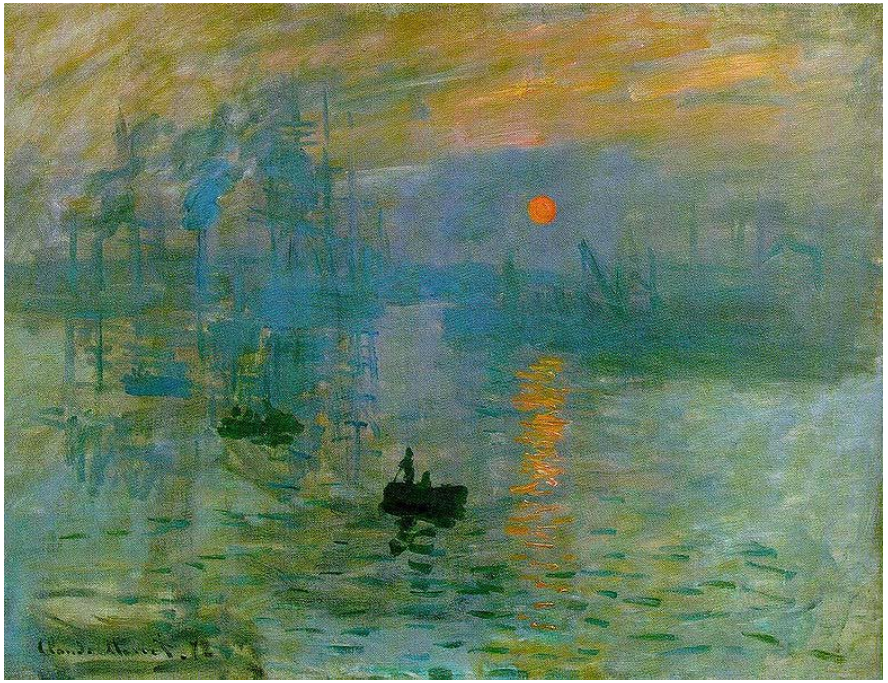
Oil Paintings

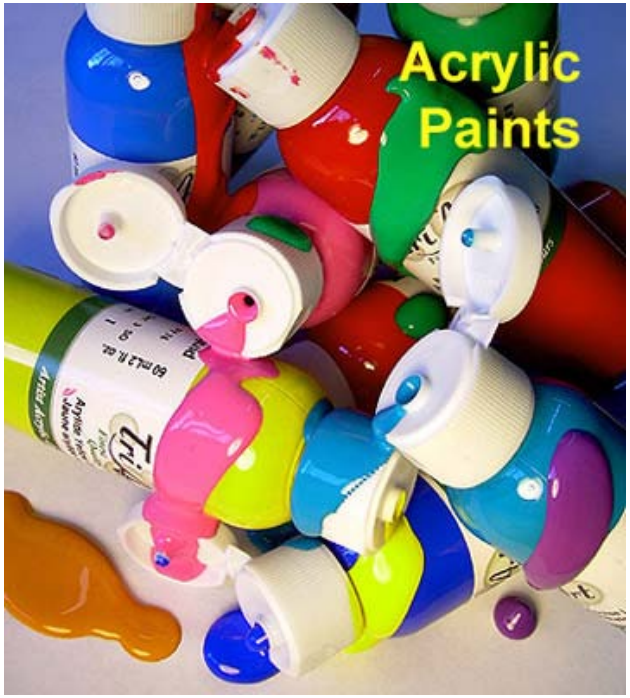
Oil Paints, pigment combined with oil discovered in early 15th century. Oil such as terpentine oil and linseed oil is the binder.



Sunrise- An impression by Monet

Starry Nights by Van Gogh

Acrylic paints and other medium



Poster Paint

Transparent Water Color

Art Restoration

• Great works of art are susceptible to effects of aging, temperature and humidity changes, and exposure to light- needs to be conserved

• Conservation involved cleaning the work, analyzing the work for damage, restoring the damaged areas and preserving the original

• Understanding the usage of pigments and binders over ages is utmost important to carry out proper restoration

Fun Activity for you

Create a pallet of natural paints. How?

Find colored rocks. Grind each rock with a mortar and pestle. Add a binder to the powdered rock. Binders can be egg yolk, starch or even glue. Now you have paints. Use these paints in a drawing. Try to identify an element or a combination of elements that produce certain colors

Acknowledgement

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Reference- Chemical Curiosities: Spectacular Experiments and Inspired Quotes by H. W. Roesky