

CHEMISTRY in our community



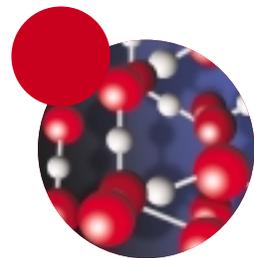
RS•C
ROYAL SOCIETY OF CHEMISTRY

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RS•C
ROYAL SOCIETY OF CHEMISTRY



Our Community
and our
environment
are chemistry!

the Chemical Universe

Everything we see, smell, touch or taste - you and me, trees, the air, baked beans on toast - is made from atoms. Atoms are the building blocks of Nature. Atoms combine in millions of different ways to form molecules and other materials so creating the Universe we live in.

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Chemistry is the study of atoms - looking at how atoms interact in Nature, how through them Nature works and discovering new molecular patterns to give us new chemical substances and materials.

Our knowledge of chemistry and the chemical sciences is growing all the time and this chemical expertise has changed the lives of most people over the last 100 years. Without chemistry our lives today would probably be shorter and would certainly be less comfortable.

This booklet will show you how creative chemistry is present in all aspects of our community - helping to feed us, clothe us, house us, entertain us and keep us healthy. Creative chemistry also provides energy and transport and is continually looking to do all these things whilst conserving scarce resources and protecting our natural environment.

CHEMISTRY IS ALL AROUND OUR COMMUNITY IMPROVING OUR QUALITY OF LIFE

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HOME

SPORT

ART & SCIENCE

FOOD

ENERGY

ENVIRONMENT

FASHION

HEALTH

THE BEAUTY
OF CHEMISTRY
Smell a flower - the
fragrance is chemistry;
see a flower - the colours
are chemistry; touch a
flower - the delicate
petal structure is
chemistry.

In the building itself the bricks and mortar, the loft insulation, the plastic damp-proofing, and the timber and preservatives are chemistry. The soft furnishings and carpets whether natural or synthetic fibre rely on chemistry for dyeing and giving easy-clean finishes.



evolution

From the attic to the kitchen, your house is chemistry.

In the building itself the bricks and mortar, the loft insulation, the plastic damp-proofing, and the timber and preservatives are chemistry. The soft furnishings and carpets whether natural or synthetic fibre rely on chemistry for dyeing and giving easy-clean finishes.

Chemistry has revolutionised our homes. Keeping our comfortable homes clean is no longer the domestic ordeal it was 100

years ago. The chemistry of detergents, washing up liquids and polishes used on easily washable surfaces ensures that cleaning is no longer a full time job.

Polymer chemistry has given us plastics that are used to make our 'phones, our vacuums, our bins and food containers amongst many other objects. Polymer chemistry has also given us non-stick surfaces such as Teflon® which make cooking (and cleaning) so much easier.



in the

- BRICKS & PAINT
- CARPETS
- TOYS
- FURNITURE
- TOOTHBRUSHES & TOOTHPASTE
- ALL CHEMISTRY

HOME

Polymer chemistry also decorates and protects our homes. Painting, inside and out, is easier due to non-drip paints that are water-based to protect the environment. Hanging the wallpaper - printed using chemical inks of course - uses pastes that are quick drying and fungicidal. And polymer fillers make sure that the wall is sound before we start.

Even the newspaper that drops through our front door involves chemical sciences for paper production and printing.

The house of the future will use new chemistry to give us windows that become transparent or opaque on command, surfaces that clean themselves and buildings that produce their own energy. The chemistry of nanotechnology, using materials with dimensions of the order of 1 to 100 nanometres (10^{-9}), could even give us intelligent houses that change their form or colour as required!

Competitive sports person or a couch potato - either way chemistry helps you relax! New materials such as carbon fibre give great strength three times stronger than steel and flexibility without the weight. Tennis rackets, golf clubs, poles for vaulting and Formula 1 racing cars all benefit from this - giving an improved performance.

Modern sports shoes are chemical marvels, from the complex adhesives that ensure the shoe remains intact under extreme conditions, to the breathing fabrics that keep your feet cool and dry. Sports drinks are formulated to supply just what the body needs during exercise.

And if you are outside playing summer sports - or just lying on the beach - don't forget the sunscreen! This essential product consists of an ultra violet (UV) absorber in a base of oil, alcohol or an emulsion and allows you to stay out longer without burning.

The home electronics that we now all take for granted need chemistry. The plastic covers, the microprocessors and the memories of PCs, PlayStation® and MiniDisc® players rely on complex chemistry. CDs, DVDs and video tape use sophisticated

optoelectronic or magnetic coatings that enable huge amounts of information to be stored in smaller and smaller volumes.

The LCD screens on GAME BOYS® and mobile phones also rely on advanced coating technology and recent advances will bring light emitting polymer screens for the next generation of devices.

Broadband internet access and digital cable TV use fibre optics that can transmit huge amounts of information over long distances - getting the chemistry of the tiny glass strands right is essential for on-demand movies.

- GOLF CLUBS
- FOOTBALLS
- DVDs
- SKATEBOARDS
- CYCLES
- TENTS AND TVs
- ALL CHEMISTRY



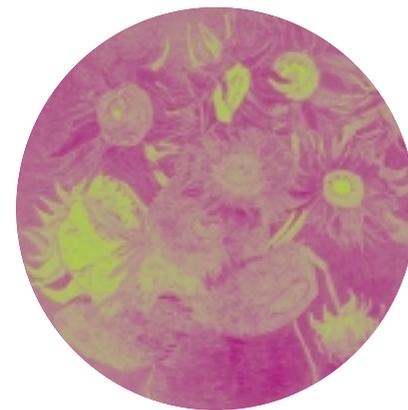
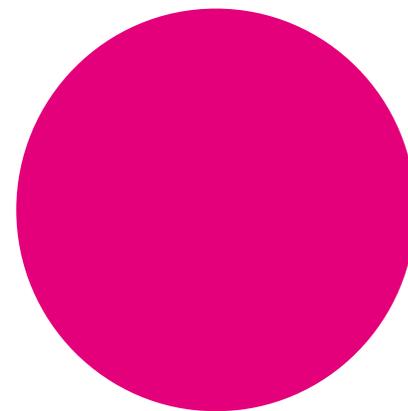
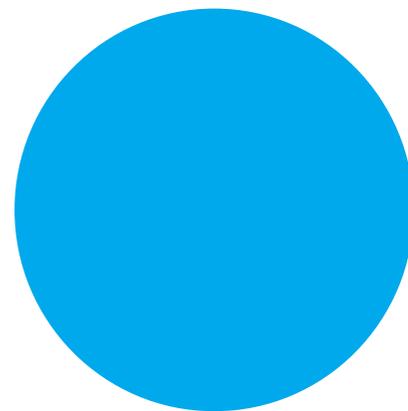
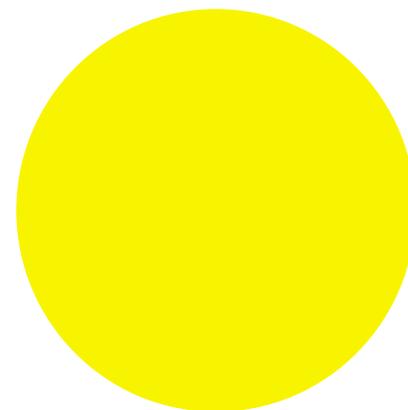
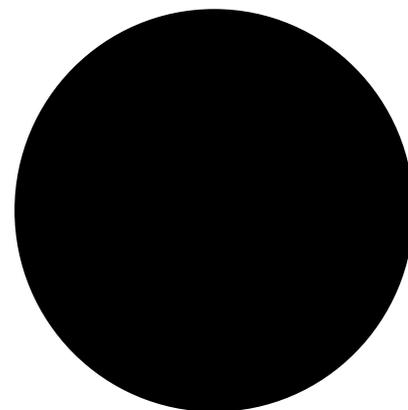
Improved performance

Chemistry is at the heart of all our sports and leisure activities.

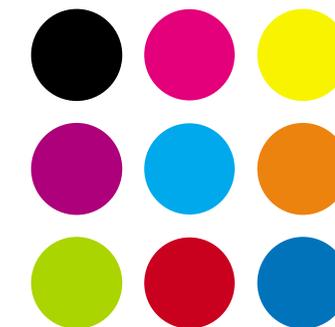
MODERN

masters

Chemistry is helping today's artists create and preserve past masterpieces



- ABSTRACT
- IMPRESSIONIST
- OLD MASTERS
- CLASSICAL OR MODERN
- ALL CHEMISTRY



Prehistoric cave paintings show that the chemistry of colour was an early human interest. Present day artists now have a huge palette of materials to create with. From formaldehyde to acrylic paints as well as traditional oil and water-base paints. Sculptors also benefit from concrete, plastics and resins.

Photography is art and chemistry. Traditional wet chemical methods for producing prints are being replaced by digital images - but chemistry is still required to make the charge coupled devices that capture the image and to produce inkjet prints.

And chemistry also plays a part in ensuring that 'old masters' will be seen by generations to come. Many traditional, vivid colours used by Turner for his sunsets or in van Gogh's Sunflowers fade or react over time, leading to a duller art. Museums and galleries around the world use chemistry to analyse and restore these masterpieces to their former glory. And further degradation can

be prevented by applying protective coatings.

Similar techniques can be used to detect forgeries and fakes, and to reveal hidden masterpieces. Carbon-dating and other archaeological chemistry helps to reveal more about our past. And polymer chemistry such as glass-reinforced polyester resins are used to preserve delicate artefacts.

Even massive artefacts, such as Henry VIII's superb wooden warship the 'Mary Rose', are now preserved for posterity using polyglycols. Modern adhesives and colour matching means that precious objects can be restored if damaged. The Roman Portland vase was restored 'as new' with chemistry.

Chemistry can also be the subject of art. The Visual Elements project has given graphic life to all 109 chemical elements that make up the chemical community. The Visual Elements periodic table by artist Murray Robertson can be seen at www.chemsoc.org/viselements/index.htm

- ICE CREAM
- BREAD
- VITAMINS AND MINERALS
- SALT & PEPPER
- FRUIT & VEGETABLES
- ALL CHEMISTRY



COOKING is chemistry!

Everything that we eat and drink is made of chemicals. Carbohydrates, fats, proteins, essential minerals and vitamins, plus the myriad of other substances that give colour, texture and flavour to our food are natural chemicals.

Cooking is probably the first chemical process invented by humans - closely followed by brewing! Cooking produces chemical changes in food - breaking bonds to make meat more tender or producing new intense flavours in roasted vegetables.

Much food chemistry is complicated - did you know that chocolate has six different crystal forms, only one of which gives that 'melt in the mouth' satisfaction? And ice cream is a complex chemical colloidal system of fat droplets, air bubbles and ice crystals. That chocolate sundae is indeed a chemical miracle!

Chemistry has been involved in keeping food fresh since the earliest times. Salting, smoking and pickling foods are processes that have been used since ancient times. Chemistry is also involved in other methods of food preservation such as bottling, canning and refrigeration.

Most food additives ('E-numbers') are naturally occurring chemicals. Monosodium glutamate (E621) is present naturally in organic cooked meat and raw tomatoes. Chemical preservatives such as sodium propionate can control bacterial and mould growth in bread allowing it to stay fresh longer.

Understanding the chemistry of nutrition is helping us to understand how diet and exercise can help us to lead healthier lives. Five portions of fruit and vegetables a day is sound chemical advice for a healthier life. And for those of us who want our sugar and fatty foods chemistry is developing substitute ingredients that mean we can have our cake and eat it!



- FOSSIL FUELS
- SOLAR POWER
- TRAINS
- PLANES & AUTOMOBILES
- - ALL CHEMISTRY

ENERGY is chemistry!

10

**Food is our source of energy
- body chemistry breaks
down the molecules in food
to provide the energy we
need to walk, talk and think.**

But chemistry is involved in giving us the energy used as part of everyday life. Chemistry helps to extract gas, oil and coal and to process these fuels for use in transport and power generation.

Chemistry provides the plastic wiring and fittings used to bring electricity to your home and workplace. Batteries are chemical devices that store electrical energy - that Walkman® wouldn't be much use without them!

The chemistry of combustion provides us with the energy that drives your car. And the means to reduce pollution from transport - all new cars in Europe are fitted with a three-way catalyst. This miniature chemical plant uses minute amounts of precious metals to convert noxious emissions such as carbon monoxide and unburnt fuel to water and carbon dioxide.



Similar systems are also reducing particulate emissions from heavy vehicles such as buses and lorries. But fossil fuels will not last forever and chemistry is developing the new energy sources that we will need. Fuel cells powered by hydrogen are now options on some cars and offer potentially 'pollution free' energy.

Chemistry plays its part in renewable energy too. Chemistry provides the lubricants used in wind turbines and the light

but strong materials used by their sails. Solar energy could give an inexhaustible, pollution-free energy supply thanks to advances in photochemistry.

And new materials mean that vehicles are lighter and stronger reducing the energy needed to get from A to B whatever the mode of transport and source of power.

11



- ORGANIC CROPS
- FERTILISERS
- INSECTICIDES
- WEED KILLERS
- CULTIVATION
- ALL CHEMISTRY

greenchemistry

To understand our environment we need to understand its chemistry.



New 'Green' Chemistry has emerged focusing on sustainable use of resources and renewable, plant-derived feedstocks. These new processes aim to have no harmful impact on the environment but will still deliver materials that give the performance that our community wants.

Chemistry has allowed us to benefit from the environment. Whether you prefer your fruit and vegetables 'organic' or 'GM' - our understanding of chemistry delivers the fruits of the environment to the supermarket shelf all the year round.

Improved agriculture has been achieved through crop nutrition, crop protection and plant breeding. Chemistry plays a vital role in modern crop management through fertilisers, pesticides and weed killers - whether natural or synthetic. Through chemistry, yields of wheat have more than doubled. Without crop protection chemicals it is estimated that over half the world's key cereal crops would be lost.

A better understanding of plant biochemistry helps all farmers whether using organic or intensive methods. Plant chemistry has been used to produce more effective, natural insecticides based on pheromones - sex attractants. A full understanding of nitrogen fixation by plants is a major goal of environmental chemistry because this will allow nitrogen from the air to act directly as a nutrient for plants.

The chemistry of cultivation extends into our gardens where slow-release fertiliser granules and selective weed killers keep our lawns in trim. Even the garden fence is protected from rot with water-based chemical preservatives that have minimal environmental impact.

FASHION is chemistry



Chemistry is what we wear and the way we look.

New fabrics, new ways with traditional fabrics, colour and cosmetics are all created by chemistry. Synthetic fabrics have brightened our wardrobes and lightened our laundry chores since nylon was first introduced in the 1940s. New materials such as polyesters and acrylics are cheap and hard wearing - and where would modern sports and leisure wear be without materials such as Lycra®!

Chemistry has also helped to make natural materials, such as cotton and wool, easier to handle with fibre finishing treatments. These surfactants modify the material to make it easier to wash and wear.

Colourful clothes have always been important. The Ancient Britons wore woad - a blue dye extracted from plants. Today your jeans are dyed using a synthetic version of indigo - the chemical found in woad. A multitude of synthetic dyes give us the vivid colours we want - but natural organic dyes are chemistry too!

The chemistry of clothing gives us light materials such as GORE-TEX® that can keep us dry in a storm but breathes to let perspiration out. In the future intelligent clothes could offer us colour changes to suit our mood or the environment - chameleon chemistry.

Cosmetics from blusher to lipstick, deodorant to hairspray rely on sophisticated chemistry. 2 in 1 shampoo needs an emulsifier for the fragrances, preservatives and cleaning components to remain as one. Chemistry derived from natural sources - plants and vegetables - to give gentle but efficient effects are an increasing trend in personal care products.

Finally jewellery - the beauty and colour of precious gems depends on subtle chemistry. Diamond is carbon. Add a dash of chromium to a lump of aluminium oxide - a rich red ruby. Substitute with titanium and iron - a brilliant blue sapphire.

- FIBRES AND FRAGRANCE
- COSMETICS AND CLOTHES
- GEMS AND JEWELLERY
- ALL CHEMISTRY



- MEDICINES
- ANAESTHETICS
- IMPROVED DIAGNOSIS
- HYGIENIC HOSPITALS
- CLEAN WATER
- ALL CHEMISTRY

Longer, Healthier Lives

All medicines, whether modern drugs or traditional herbal remedies, rely on chemistry.

The first chemical substances used to treat illness were extracted from plants - the Ancient Egyptians used the foxglove plant as a heart medicine. And today the anti-cancer drug Taxol® is derived from the Pacific Yew Tree. Other modern drugs such as the antibiotic penicillin are based on chemistry found in Nature.

Chemistry can also be used to make new manmade medicines. Either reproducing molecules found in nature, perhaps adapting or refining the properties of natural chemistry, or producing brand new molecules with new properties to cure previously fatal illnesses.

The chemical sciences have helped to control or eradicate many diseases. The chemistry of our body is extremely complicated. Chemists and biochemists are continually improving our understanding of how the body works. New medicines to combat difficult illnesses, such as asthma and Alzheimer's, or new challenges, such as HIV/AIDS, need new molecules - new chemistry.

Accurate diagnosis of disease relies on modern analytical chemistry. Blood and urine can be analysed in minute detail. Whole body magnetic resonance imaging (MRI) scanners use technology originally developed for research in chemistry.

And modern surgery is no longer a life threatening event thanks to anaesthetics, painkillers, antibiotics and the high levels of medical hygiene achieved by modern chemical cleaners. Chemistry also provides the dissolving stitches and biodegradable dressings which should make a stay in hospital shorter and recovery more comfortable.

Many drugs have made a major impact on our life-styles. The contraceptive pill had a huge social impact and other drugs allow people with severe, long-term illnesses to live near normal lives. But the biggest health impact of chemistry is useable, drinkable water 'on tap' in every home. Chemistry cleans and purifies our water - and clean water means good health.

CHEMISTRY IS CREATIVITY - CHEMISTRY IS OUR COMMUNITY