

Chemical safety in the classroom - helping your students understand what it's all about

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Outline

- Why is safety important?
- How should we teach safety?

Safety is important because...

(1)

Laboratories are dangerous places



The methanol flame test

Safety is important because...

(2)

- Through safety we can teach science
- **Why is methanol dangerous?**
- ... it burns
- ... it has a non-luminous flame
- ... it is very volatile, so dangerous levels of vapour can build up

Safety is important because...

(3)

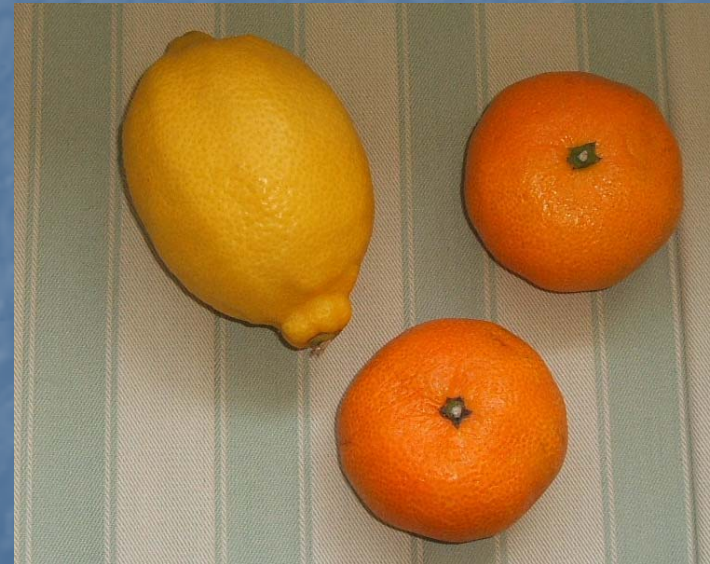
A proper understanding of chemical properties is crucial
(particularly for adults!)



Phenylimidazopyridine

Acetaldehyde

Sudan I

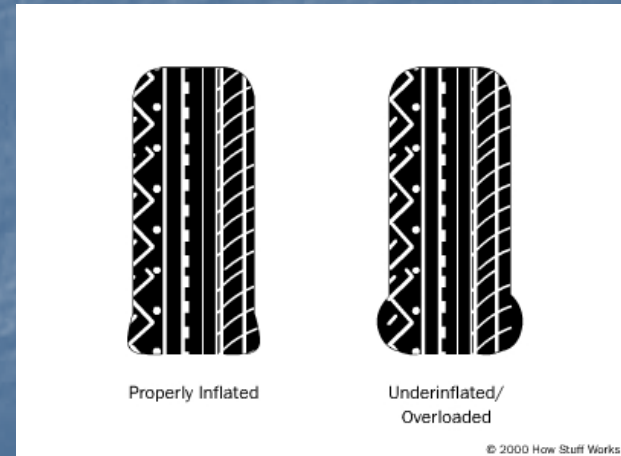


Principles of teaching safety

- 1. Impose a **requirement** of safe working
- 2. Do not put students off
- 3. Be cautious about treating safety as a standalone topic

More principles

4. Safety is crucial from the moment that an experiment begins



Preparation

- 5. Offer students information, but encourage them to research safety data for themselves. This must be recorded **before** the experiment begins.

- Is a new chemical



or just



?

More preparation

- 6. Spread the burden of preparing safety notes among students

- 7. Tailor your approach to each group

The screenshot shows a PDF document titled "Suite.HsSigmaAdvancedSearch.pdf" in Adobe Reader. The document is a Material Safety Data Sheet (MSDS) for SIGMA-ALDRICH ACETONE. The interface includes a menu bar (File, Edit, View, Document, Tools, Window, Help), a toolbar with various icons, and a sidebar with "Pages", "Attachments", and "Comments" tabs. The main content area displays the following information:

SIGMA-ALDRICH

Material Safety Data Sheet

Date Printed: 08/JUL/2005
Date Updated: 17/MAY/2004
Version 1.8
According to 91/155/EEC

1 - Product and Company Information

Product Name	ACETONE, 99.9%, PRA GRADE
Product Number	323969
Company	Sigma-Aldrich Company Ltd. The Old Brickyard New Road, Gillingham SP8 4XT
Technical Phone #	44-(0)-1747-833000
Fax	44-(0)-1747-833313
Emergency Phone #	44-(0)-1747-833100

2 - Composition/Information on Ingredients

Product Name	CAS #	EC no	Annex I Index Number
ACETONE	67-64-1	200-662-2	606-001-00-8

Formula C3H6O
Molecular Weight 58.08 AMU
Synonyms Aceton (German, Dutch, Polish) * Acetone (ACGIH:OSHA) * Chevron acetone * Dimethylformaldehyde * Dimethylketone * Dimethyl

The bottom of the window shows a status bar with "1 of 8" pages and navigation icons.

Background

- 8. Explain at an early stage that everything is chemical.



Safety and demonstrations

- 9. Give every demonstration a scientific justification - science can (should...) be entertaining, but is not about entertainment



Scientific debate

- 10. Environmental debates can be helpful. Encourage students to take sides, but conduct the debates in an unbiased and science-based fashion.



Safety and the environment

- 11. Encourage students to recognize the links between environmental and ethical issues alongside the science...
- 12. ...and to appreciate that environmental issues are often complex (effectiveness may be a trade-off against toxicity)



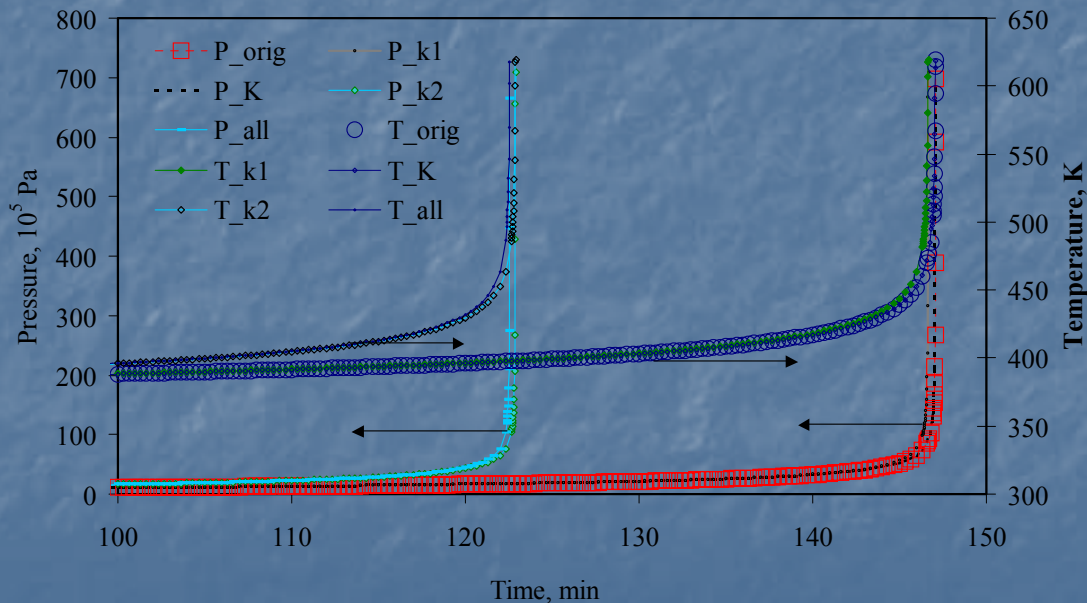
Safety and chemistry

- 13. Relate the hazards posed by a chemical to its position on the periodic table and to the behaviour of similar chemicals

1 H Hydrogen 1.01																	2 He Helium 4.003
3 Li Lithium 6.94	4 Be Beryllium 9.01											5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.18
11 Na Sodium 22.99	12 Mg Magnesium 24.31											13 Al Aluminium 26.98	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulphur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.95
19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 47.90	23 V Vanadium 50.94	24 Cr Chromium 51.996	25 Mn Manganese 54.94	26 Fe Iron 55.85	27 Co Cobalt 58.93	28 Ni Nickel 58.70	29 Cu Copper 63.55	30 Zn Zinc 65.37	31 Ga Gallium 69.72	32 Ge Germanium 72.59	33 As Arsenic 74.92	34 Se Selenium 78.96	35 Br Bromine 79.90	36 Kr Krypton 83.80
37 Rb Rubidium 85.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.22	41 Nb Niobium 92.91	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 107.87	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.69	51 Sb Antimony 121.75	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.30
55 Cs Caesium 132.91	56 Ba Barium 137.33	57 La Lanthanum 138.91	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.85	75 Re Rhenium 186.21	76 Os Osmium 190.20	77 Ir Iridium 192.22	78 Pt Platinum 195.09	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.37	82 Pb Lead 207.19	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium 226.03	89 Ac Actinium 227.03	10 Rf Rutherfordium (261)	10 Ha Hahnium (262)	10 Sg Seaborgium (263)	10 Ns Nielsbohrium (262)	10 Hs Hassium (265)	10 Mt Meitnerium (266)	11 0 (271)	11 1 (272)	11 2 (277)	(113)	(114)	(115)	(116)	(117)	(118)

Safety in processes

- 14. Demonstrate that both the properties of chemicals and those of processes may present hazards (why has the runaway occurred?)



Sources of safety information

- Chemical suppliers (e.g. Sigma Aldrich)
 - <http://www.sigmaaldrich.com/>
- HSci chemical safety database
 - <http://ptcl.chem.ox.ac.uk/~hmc/hsci>
- Physical & Theoretical Chemistry Lab, Oxford University, Safety database
 - <http://ptcl.chem.ox.ac.uk/MSDS>