

# Chemical safety in the classroom - helping your students understand what it is 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...

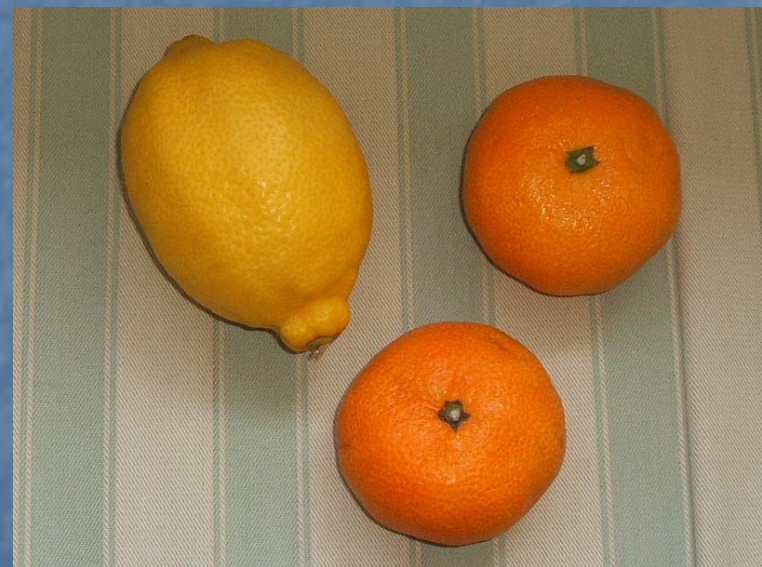
## (3)

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

Phenylimidazopyridine

Acetaldehyde

Sudan I

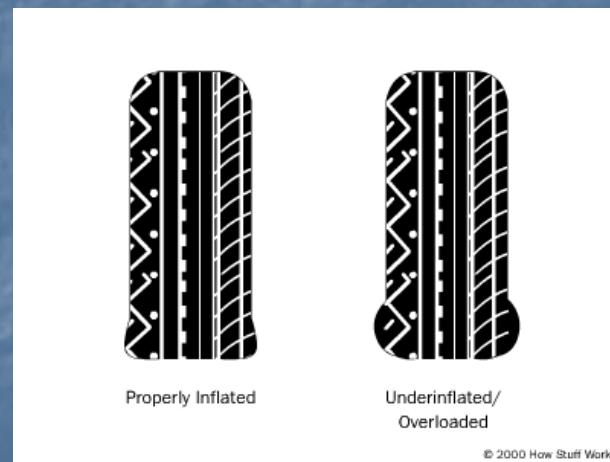


# Principles of teaching safety

- 1. Do not put students off
- 2. Do impose a requirement of safe working
- 3. Be cautious about a standalone safety course

# 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

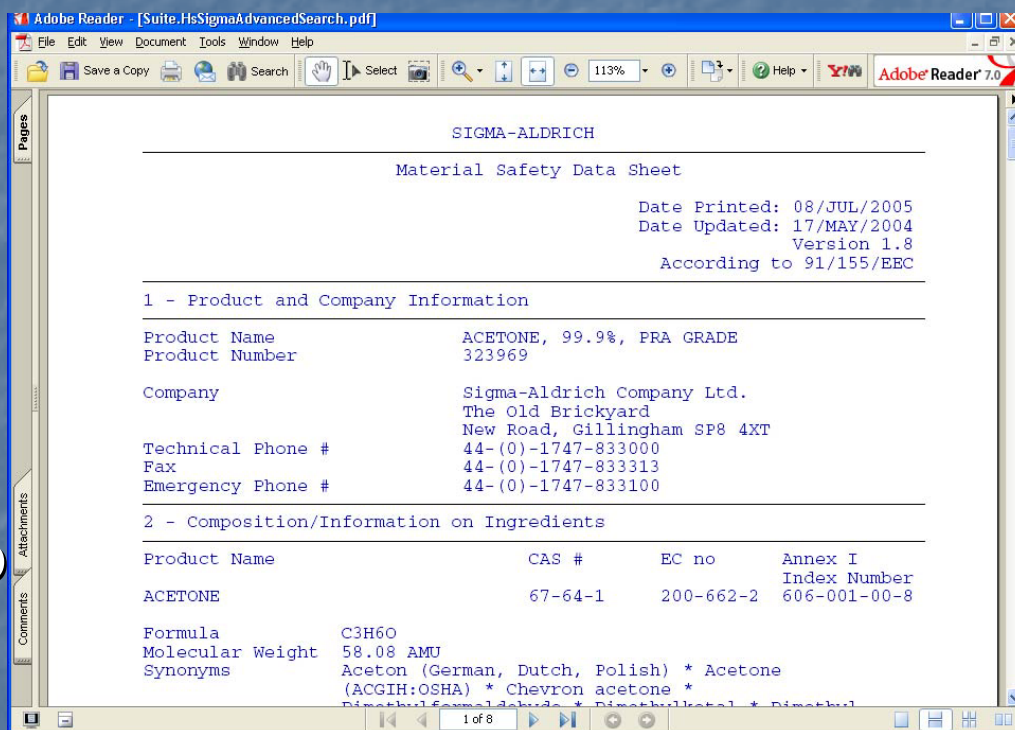


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# More preparation

- 6. Spread the burden of preparing safety notes among students
- 7. Tailor your approach to each group



The screenshot shows a PDF document titled "SIGMA-ALDRICH Material Safety Data Sheet" for Acetone. The document is displayed in Adobe Reader 7.0. The MSDS includes 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: C<sub>3</sub>H<sub>6</sub>O  
Molecular Weight: 58.08 AMU  
Synonyms: Aceton (German, Dutch, Polish) \* Acetone (ACGIH:OSHA) \* Chevron acetone \* Dimethylformaldehyde \* Dimethylketone \* Dimethyl...

# Background

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



# Safety and demonstrations

- 9. Give every demonstration a scientific justification



# Scientific debate

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



# Safety and the environment

- 11. Encourage students to recognize the links between environmental and ethical issues...
- 12. ...and to appreciate that environmental issues are often complex



# Safety and chemistry

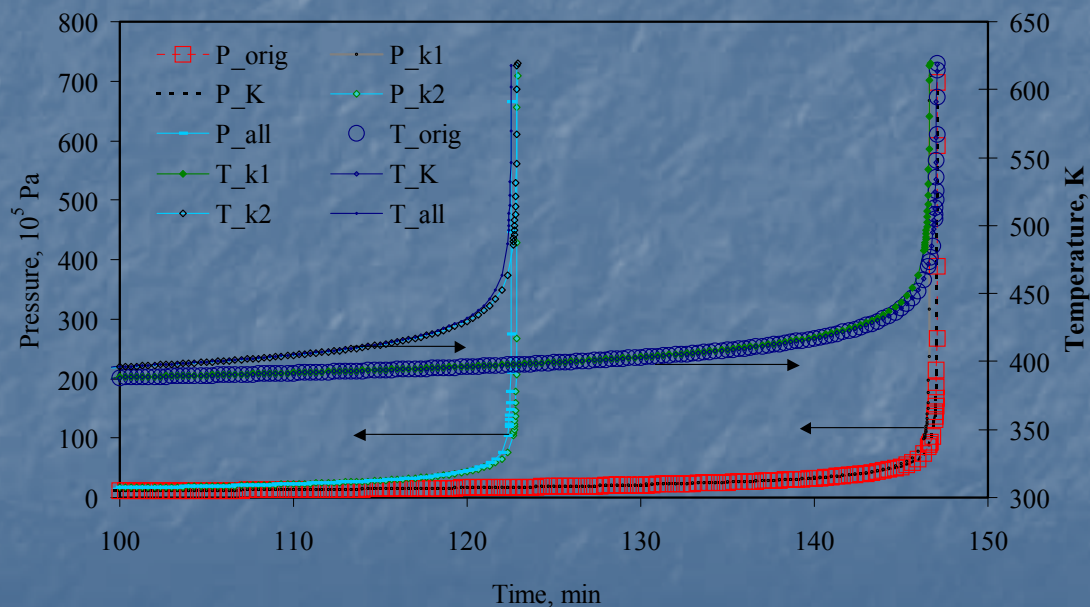
- 13. Relate the hazards posed by a chemical to its position on the periodic table and to the behaviour of similar chemicals

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)

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# Safety in processes

- 14. Demonstrate that both the properties of chemicals and those of processes may present hazards



■ Papadaki et al (Leeds University)

# Sources of safety information

- 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>
- Chemical suppliers (e.g. Sigma Aldrich)
  - <http://www.sigmaaldrich.com/>