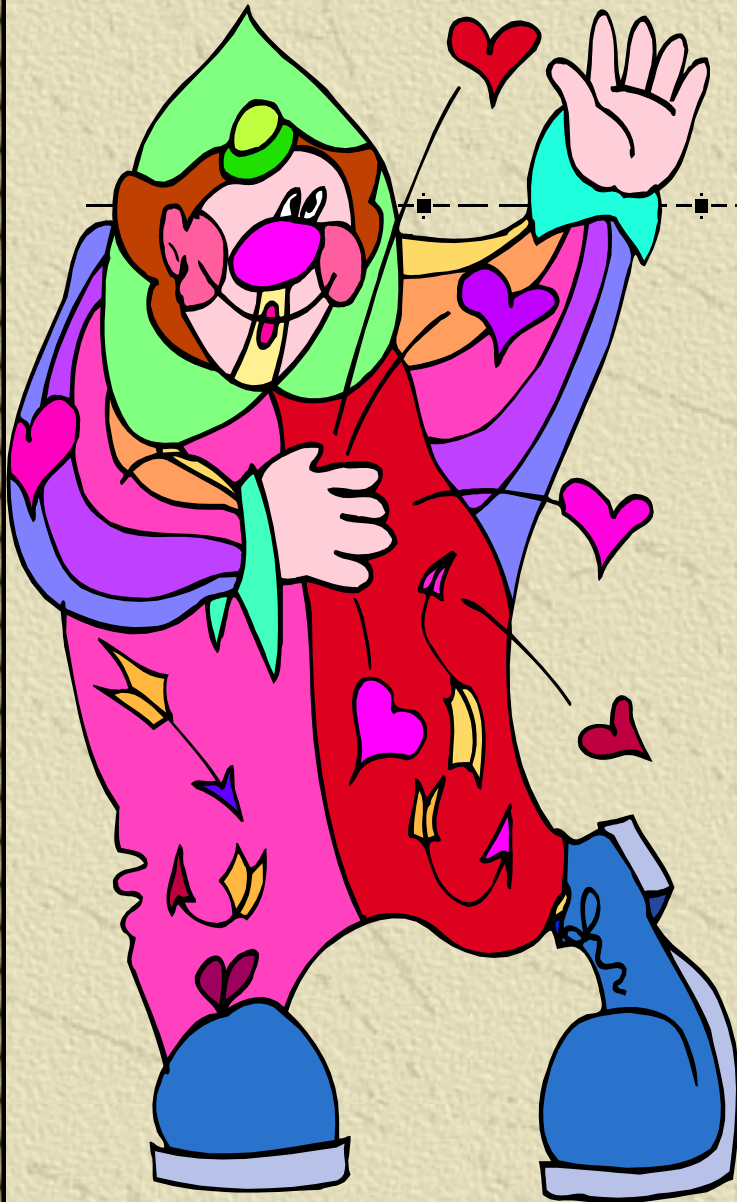


The World is Changing

& Students need to be Empowered for the
Change

Frankie Wood-Black
Spring ACS Meeting 2007

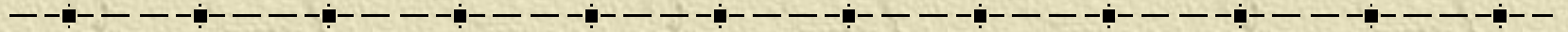


Now here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!

Lewis Carroll (1832–98), English author, mathematician. The Red Queen in *Through the Looking-Glass*, ch. 2, (1872).

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The Rime of the Ancient Mariner

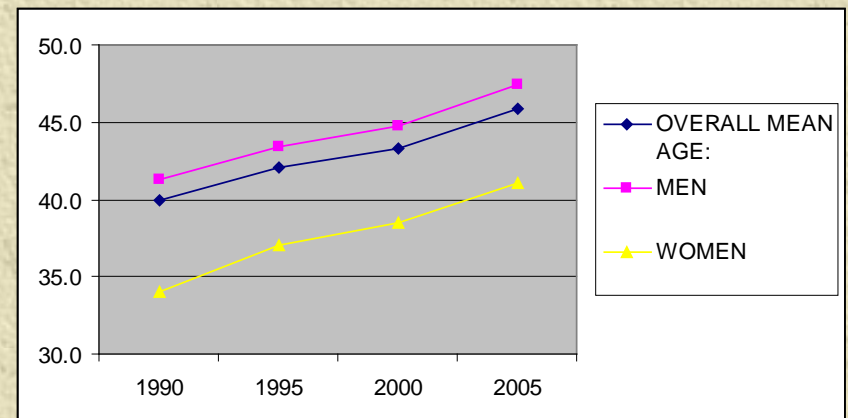
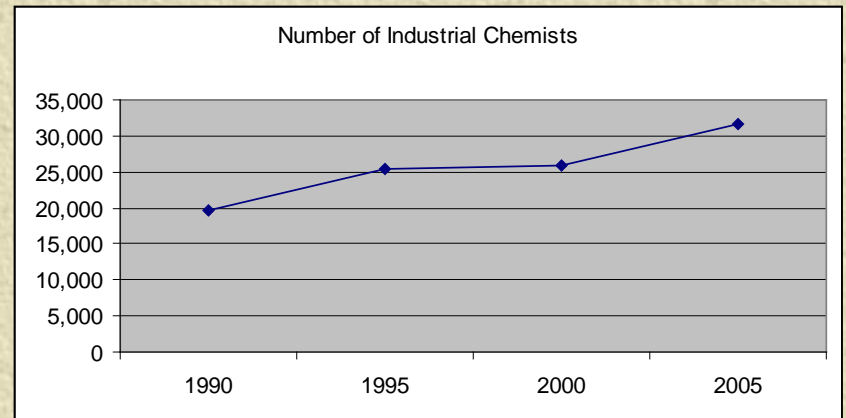


**Water, water everywhere,
Nor any drop to drink**

Samuel Taylor Coleridge

Industry is Growing & Graying

However, the Bureau of Labor Statistics indicates that the rate of growth will be slower than other disciplines.

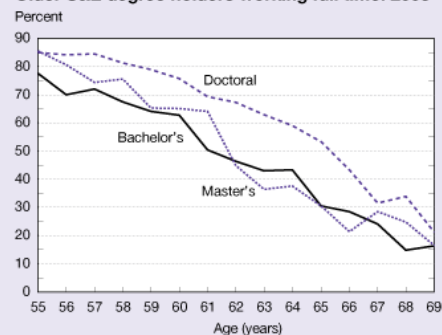


The Graying of Industry – Concern for the Future

Median Age is Increasing

AGE	INDUSTRIAL CHEMISTS	Men		Women	
		2000	2005	2000	2005
20-29		5.6%	3.7%	17.5%	14.0%
30-39		26.4	20.1	39.8	32.9
40-49		34.1	32.2	28.8	31.4
50-59		26.8	32.2	11.7	17.7
60-69		6.9	11.9	2.2	4.0
70 OR MORE		0.1	0.0	> 0.1	0.0
TOTAL		100.0%	100.0%	100.0%	100.0%
	NUMBER OF CHEMISTS	19,632	14,407	5,941	4,313
CITIZENSHIP	NATIVE AMERICAN	79.6%	79.3%	77.0%	78.3%
	NATURALIZED AMERICAN	10.3	11.4	12.3	11.4
	PERMANENT RESIDENT				
	ALIEN	7.5	7.3	8.0	7.3
	OTHER VISA	2.6	3.0	2.8	3.0
	TOTAL	100.0%	100.0%	100.0%	100.0%
	NUMBER OF CHEMISTS	19,662	14,385	5,965	4,298
ETHNICITY	HISPANIC	2.2%	2.2%	3.3%	3.2%
	NON-HISPANIC:				
	WHITE	84.2	84.0	79.0	80.6
	BLACK	1.4	1.3	2.9	2.5
	NATIVE AMERICAN	0.1	0.1	0.2	0.1
	ASIAN	10.9	11.5	13.9	13.0
	OTHER	1.1	0.8	0.7	0.5
TOTAL	100.0%	100.0%	100.0%	100.0%	
	NUMBER OF CHEMISTS	18,006	14,244	5,498	4,274

Figure 3-35
Older S&E degree holders working full time: 2003



SOURCE: National Science Foundation, Division of Science Resources Statistics, SESTAT, preliminary estimates (2003), <http://sestat.nsf.gov>. See appendix table 3-14.

Science and Engineering Indicators 2006



Employer “Wish List”

- ✦ Dependability
- ✦ Goal Orientation
- ✦ Positive Attitude
- ✦ Flexibility/Willingness to Learn
- ✦ Motivation
- ✦ Organization/Attention to Detail/Time Usage
- ✦ Initiative
- ✦ Problem Solving/Analytical Skills
- ✦ Stress (Ability to Handle)
- ✦ Career Ambitions

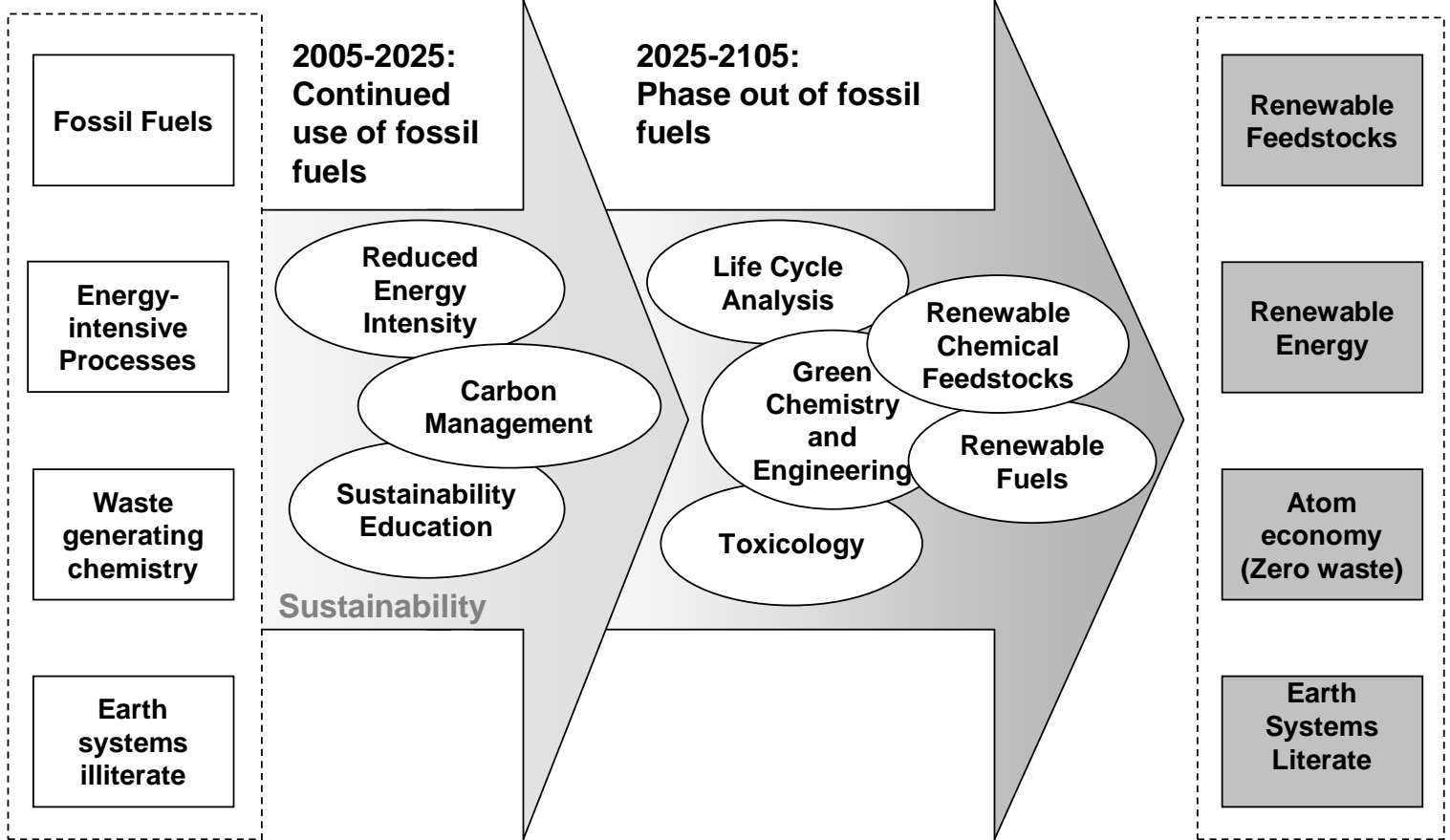
Is the Traditional Approach to Education Going to Prepare Students?

- ✦ Curriculum
- ✦ Teaching Styles
- ✦ Educational Approach
- ✦ Team Skills
- ✦ Communication Skills

Grand Challenges to address the transition from current thinking to the ideal vision for the chemical industry over the next 100 yrs

Current Paradigm

Ideal Vision



Fossil Fuels

Energy-intensive Processes

Waste generating chemistry

Earth systems illiterate

2005-2025:
Continued use of fossil fuels

2025-2105:
Phase out of fossil fuels

Reduced Energy Intensity

Carbon Management

Sustainability Education

Sustainability

Life Cycle Analysis

Green Chemistry and Engineering

Toxicology

Renewable Chemical Feedstocks

Renewable Fuels

Renewable Feedstocks

Renewable Energy

Atom economy (Zero waste)

Earth Systems Literate

2005

2025

2105

Year

Who is a Coachable Employee?

- ✦ Desire for a stronger sense of self-awareness.
- ✦ Want to grow personally, or within their profession.
- ✦ Seek results-oriented progress through goal setting and attainment.
- ✦ Value self-discovery.
- ✦ Want a clearer perspective of where to use their finite energy.

Communication Protocols

- ✦ Agenda – Yours and Others
- ✦ Know the Rules
- ✦ Body Language
- ✦ Introductions & Ice Breakers
- ✦ Listen, Listen

Sustainability Education

Advances in chemistry and engineering must be accompanied by cross-disciplinary education in sustainability science and its application to the business community. This includes greater understanding of:

- ◆ earth systems science and engineering,
- ◆ ecology,
- ◆ green chemistry and engineering,
- ◆ biogeochemistry,
- ◆ life cycle analysis,
- ◆ toxicology

Education Research Needs

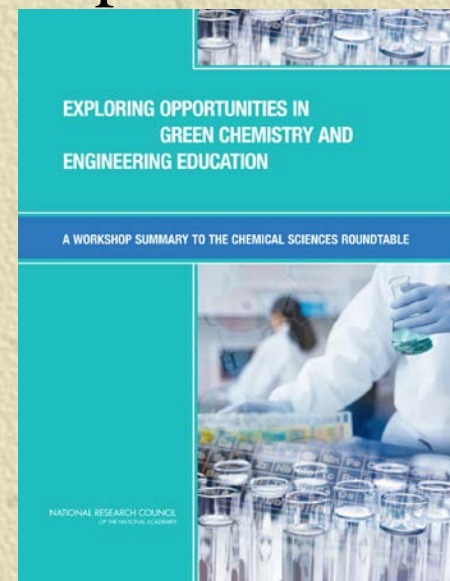
-
- ✦ Provide professional development opportunities for educators
 - ✦ Persuade professional societies to integrate sustainability concepts into educational materials, standardized testing, accreditation, and certification programs.
 - ✦ Incorporate sustainability concepts across secondary and tertiary education curricula.
 - ✦ Provide professional development for current and future managers and executives.

Exploring Opportunities in Green Chemistry

✦ Workshop of the Chemical Sciences Roundtable.

✦ Current Status

- ✦ Barriers to introduction of “new” topics into an already crowded curriculum.
- ✦ Lack of available resources
- ✦ Multidisciplinarity of the topic



Goals of the Workshop

- ✦ Examine place in future curricula
- ✦ What materials, programs, and tools are needed?
- ✦ What is needed to achieve interdisciplinary approaches
- ✦ Green chemistry and engineering industry and education
- ✦ The new faculty
- ✦ Creating incentives, removing impediments.

Skills and Attitudes Needed for the Future

- ✦ Sensitivity to the Environment
- ✦ Sensitivity to Human Needs
- ✦ An Ethical Foundation
- ✦ Understanding of Natural Systems
- ✦ Understanding of Social Systems

Cliff Davidson –

Exploring Opportunities in Green
Chemistry and Engineering Education

Additional Skills – Promote Retention and Prepare for Future


- ✦ Systems Thinking
- ✦ Meaningful Context
- ✦ Integration of Support Subject Domains
- ✦ Interaction with Faculty as Coaches
- ✦ Active Learning and Design
- ✦ Connection with Peers
- ✦ Reflection and Self-Assessment

Linda Vanasupa, Exploring Opportunities in Green Chemistry and Engineering Education



“
**It is not necessary
to change.
Survival is not
mandatory.”**

W. Edwards Deming as quoted in
Today's Chemist at Work
August, 1999



“The future enters into us,
in order to transform itself in us,
long before it happens.”

Poet Rainier Maria Rilke