

# Green Chemistry Benefits to Universities, States and the Marketplace

## Better Living through Green Chemistry

*Nicholas D. Anastas, Ph.D*

*Senior Advisor for Green Chemistry*

*ORD/NRMRL*

*[Anastas.Nicholas@epa.gov](mailto:Anastas.Nicholas@epa.gov)*

# Green Chemistry *is*

- Pollution prevention at the molecular level
- Sustainable chemistry
- Benign by design
- Design for the environment
- Preventive or Holistic chemistry
- Scientifically based
- Economically sound
- What you ***Can*** do

**Green Chemistry Pocket Guide**

**The 12 Principles of Green Chemistry**

Provides a framework for learning about green chemistry and designing or improving materials, products, processes and systems.

1. Prevent waste
2. Atom Economy
3. Less Hazardous Synthesis
4. Design Benign Chemicals
5. Benign Solvents & Auxiliaries
6. Design for Energy Efficiency
7. Use of Renewable Feedstocks
8. Reduce Derivatives
9. Catalysis (vs. Stoichiometric)
10. Design for Degradation
11. Real-Time Analysis for Pollution Prevention
12. Inherently Benign Chemistry for Accident Prevention

[www.acs.org/greenchemistry](http://www.acs.org/greenchemistry)

 ACS  
Chemistry for Life®

 ACS  
Green  
Chemistry  
Institute

# Green Chemistry is *not*

- A regulatory tool
- Mysterious
- Environmental chemistry
- An all or nothing proposition
- A list of what you *Can't* do



# Looking at Green Chemistry

- Narrow Focus
  - *Reducing hazard*
  - *Lab-centric*
  - *Beaker and flask hazard reduction*
- Broad focus
  - *Using bio-renewable feedstocks*
  - *Making safer chemicals*
  - *Reducing waste*
  - *Designing for degradation*
  - *Ultimate source reduction tool*



# Spreading the good news

- Cutting edge science
  - Computational Toxicology and Chemistry
  - Exposure Science
  - Risk Assessment
- Integrative
- Promote Lifecycle thinking
  - LCA efforts



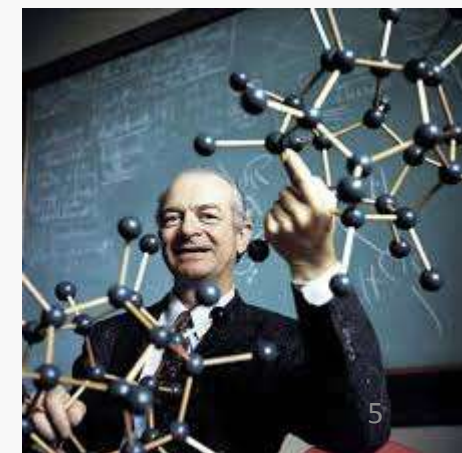
The Society will make your contributions to the SOT Endowment Fund sound even sweeter with a 1 to 1 dollar match of your contribution.

Your generous contributions to the SOT Endowment Fund help support the following:

- ☑ Underwriting of Student Travel Awards to the SOT Annual Meeting.
- ☑ Recognizing those colleagues who have devoted their careers to educating undergraduate students who in turn have helped us build a strong future for toxicology.
- ☑ Strengthening global participation through financial support for scientists to travel from developing countries to attend the SOT Annual Meeting.
- ☑ Recognizing those toxicologists who have made significant contributions to improving human health and the environment.

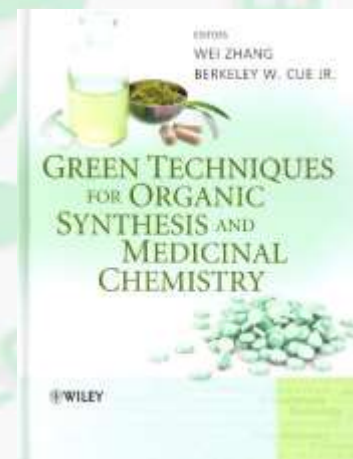
The 1 to 1 dollar match is effective for contributions made between July 1, 2013 until June 30, 2016 or until \$400,000 in matching funds have been expended.

Courtesy of SOT



## *In Universities*

- Enhancing the chemistry curriculum
  - Embedding green chemistry
  - Embedding toxicology
  - Working at the nexus of chemistry and biology through toxicology
- Advancing 21<sup>st</sup> century toxicology
  - Paradigm shift



## *In States*

- State involvement
  - Partnerships needed
- State needs
- State resources
  - Green chemistry P2 workgroup



Northwest  
Green Chemistry



## *In the Marketplace*

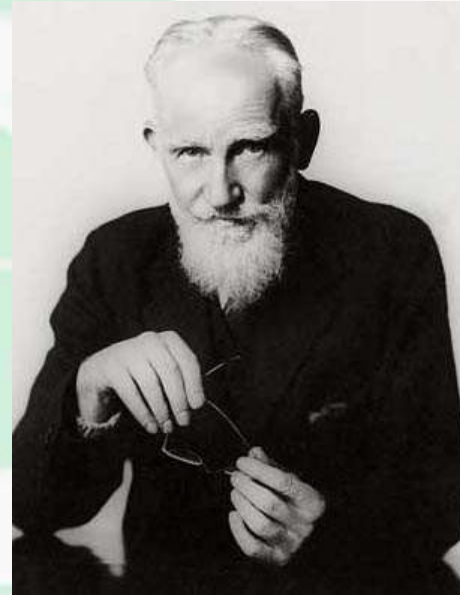
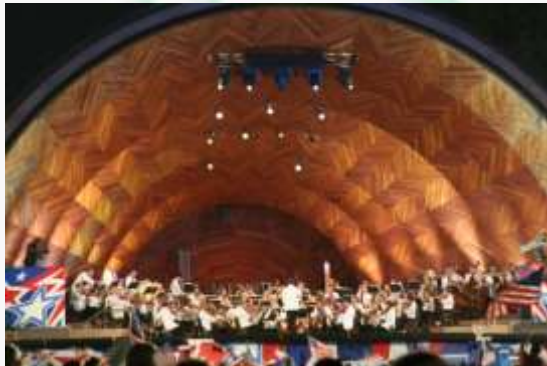
- Safer Choice
- Alternatives Assessments
- *De novo* design/green chemistry
- Green Toxicology





## Conclusions

- Let the word go forth.....
- Seek partnerships more widely
  - Match need with product
- Environmental Orchestra



**You see things; and you say, 'Why?'**  
**But I dream things that never were;**  
**and I say, 'Why not?'**

- George Bernard Shaw

TwistedSifter.com

“For the benefit of earth and it people”