AACT Symposium

INTEGRATING THE 12 PRINCIPLES OF GREEN CHEMISTRY THROUGH STUDENT CENTERED ACTIVITIES
How did I become a greener chemistry teacher?

- Flint water crisis (catalyst)
- ACS Science Coach
- American Association of Chemistry Teachers (AACT)
- ACS ChemClub
- ACS member for 25 years
Green Chemistry Research

- Goals (2)
  - Allow students to drive the process
  - Share your research findings
  - May want to start with your ChemClub/Sustainability Club first before you try a research activity with your class
- Benefits of an ACS Science Coach
Mindset

▶ Green Chemistry Growth Mindset (GCGM)

Mindset

- Operate with the idea that the other person has the better idea
- NCC
Start with small green chemistry steps in your classroom.

- How can we reduce water consumption?
- How can we reduce energy consumption?
How do you teach green chemistry to your students?
There are three basic ways I teach green chemistry.

1) Discussion (ADOs)
2) Student Research
3) Teacher Led Examples
Pick a green chemistry activity that has high impact.
Gases unit and tie in to green chemistry

- Relevance factor
- Air conditioning and refrigerants
- CFCs versus HFCs
CFC-12 (early 1990’s) versus HFC-134a (now)

<table>
<thead>
<tr>
<th>MVAC* Refrigerant</th>
<th>Molecule</th>
<th>Global Warming Potential</th>
<th>Ozone Depleting?</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFC-12</td>
<td><img src="image" alt="CFC-12 molecule" /></td>
<td>10,900</td>
<td>Yes</td>
</tr>
<tr>
<td>HFC-134a</td>
<td><img src="image" alt="HFC-134a molecule" /></td>
<td>1,430</td>
<td>No</td>
</tr>
</tbody>
</table>

*MVAC stands for motor vehicle air conditioning.
HFC-134a (now) versus ??? (future)

| Environmental impacts of Motor Vehicle Air Conditioning (MVAC) Refrigerants |
|---------------------------------|------------------|
| MVAC Refrigerant                | Global Warming Potential |
| HFC-134 a                       | 1,430             |
| HFC-152a                        | 124               |
| HFO-1234yg                      | 4                 |
| CO₂ (R-744)                     | 1                 |

*This table was reformatted from an EPA website*
Share

- Collaborate with other teachers
ACS Science Coach Program

- Must be an AACT member.
- $550 donation if money goes straight to Flinn Scientific
Material Science and GC connections

- Energy consumption
- School newspaper
Making a cleaning solution from a polylactic acid cup

- Background for this lab can be found on the Beyond Benign’s website under curriculum, then click on 1) high school and 2) acids and bases.
Innovate

- Science Fairs
- Science Olympiad
- Any STEM competition
Research

- Present at ACS conferences
- Put research posters up in building
Get out of your bubble and do green chemistry.
Write a book chapter

- Consider writing a book chapter on green chemistry connected to the United Nations Sustainable Development Goals

- Contact me: kosmass@gpschools.org
Sources:

- https://www.epa.gov/ozone-layer-protection/basic-ozone-layer-science
- https://www.epa.gov/mvac/refrigerant-transition-environmental-impacts
- https://www.epa.gov/ozone-pollution-and-your-patients-health/what-ozone
- https://theozonehole.com/ozonedestruction.htm
- https://www.nextgenscience.org/topic-arrangement/hshuman-sustainability
Sources Page 2

- https://teachchemistry.org/ (link to AACT website)
- https://www.beyondbenign.org/
- https://www.acs.org/content/acs/en/education/students/highschool/chemistryclubs.html
- https://www.acs.org/content/acs/en/greenchemistry/principles/12-principles-of-green-chemistry.html
Thank you for your attention and interest in green chemistry.

- Don’t forget your mantra.
- Steve Kosmas  (kosmass@gpschools.org)
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- Beyond Benign Lead Teacher
  - I respond to all forms of new media (e.g. telegrams, snail mail, email, telephones etc.)