WORKER AND ENVIRONMENTALIST GREEN CHEMISTRY AWARENESS Training Curriculum

Appendix C

Alternative Curriculum for Specific Settings

Green Chemistry & Green Jobs in Residential Weatherization Work

This manual was developed by the New England Consortium. Grant funded by The National Institute of Environmental Health Sciences Grant No. 3U45ES006172-18S2, titled: “Administrative Supplements to Promote Partnerships for Environmental Public Health.”
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Appendix C

Alternative Curriculum for Specific Settings
Green Chemistry & Green Jobs in Residential Weatherization Work

About this training: Clean Water Action, a leader in the Alliance for a Healthy Tomorrow, (www.healthytomorrow.org) partnered with MassCOSH (www.masscosh.org) and the Green Justice Coalition (www.massclue.org/green-justice-coalition) to present a workshop on green chemistry and green jobs in residential weatherization. Training participants were members of community organizations in the Green Justice Coalition.

More about the Green Justice Coalition (GJC): In December 2008, the GJC launched a campaign to bring home energy-efficient upgrades and jobs to Boston's low-income communities and communities of color. GJC is a partnership of community groups, labor unions, environmental groups, and other organizations that support a sustainable, equitable, and clean energy economy in the Boston region. Low-income communities and communities of color have been overburdened by our unsustainable economy. GJC wants to ensure that these communities are at the forefront of the growing green, sustainable economy. GJC is committed to making sure that our region’s growing green economy creates quality jobs, local workforce development opportunities, and healthier and safer communities.

Agenda

Training: 3 hours total

Learning objectives: Understand how the 12 green chemistry principles can be applied in practice to a particular environmental, health and safety application: weatherization work. Understand how green chemistry principles can be integrated into existing campaigns and efforts to reduce toxic contamination.

Materials:
- Flip chart/ markers
- Sticky notes
- Supplies for glue making recipe
- Handouts and posters for each activity
Introductions and discussion of a broader definition of green jobs  
15 minutes

Activity One: Scope of the Problem  
30 minutes

Activity Two: Green chemistry in action: making glue  
45 minutes

BREAK:  
5 minutes

Activity Three: Weatherization and green chemistry:  
60 minutes
how to make our homes and our jobs safer

Evaluation and wrap-up  
25 minutes
**Trainer Notes:** Introductions: Green Chemistry is an approach that we would like to share with community members in the Green Justice Coalition as a tool to make our homes and our jobs safer.

Each person introduces themselves and says one sentence answering the questions: What do you think of when you hear the phrase “green jobs”?

Make a list on the flip chart.

**Handout:** What Makes A Job Green? – The Four G’s. This is the way we are looking at green jobs. We will be looking at strategies to reduce adverse health impacts and increase access to good, quality, green jobs.
### What Makes a Job Green? – The Four G’s

| **Green collar** | The product produced or service offered is environmentally “green” such as:  
|                  | • Solar panels and wind turbines  
|                  | • Weatherization for energy efficiency  
|                  | • Recycling materials  
|                  | • Mass transit equipment  
|                  | • Clean-up of polluted land |

| **Green lungs** | The workplace environment is “green” in terms of worker health and safety such as:  
|                 | • Less toxic chemicals are substituted for more toxic chemicals  
|                 | • Re-engineering the work process is done to reduce exposure to toxic materials or dangerous conditions  
|                 | • Personal protective equipment (which can tear and leak) is the last resort in protecting workers |

| **Green belt** | The community environment is “green” in that the facility does not increase pollution in the immediate area such as:  
|                | • Air and water pollution  
|                | • Minimum carbon footprint in relation to fuel consumption or pollution from transportation to and from the facility  
|                | • The facility site is not left contaminated (a brownfield) |

| **Green wallet** | There is economic justice for the employees and community such as:  
|                  | • Adequate living wages for a family, and employees are treated with respect and dignity recognizing the contributions of all employees  
|                  | • Affordable and comprehensive healthcare is provided, as well as a decent pension  
|                  | • Adequate compensation such as taxes is made to the community in relation to the revenue the company receives |

**Make green jobs green through and through**
Activity One – Worksheet

Scope of the Problem

Purpose

To review the state of protections currently in place and how secure we feel about toxic exposures at our jobs, in our homes and in the environment.

This activity has three tasks.

Task 1:
- Assign a “scribe” at your table who will keep describe the tasks for the activity.
- Divide the 6 fact sheets among the small group to read. (Depending on the size of your group you can have each person read one fact sheet or share each fact sheet with two or more people.)
- Each reader at the table tells the group what they learned from the fact sheet (in order of how they were assigned).

Task 2:
- Share one example of how these gaps affect you at work, in your community, or in your family.

Task 3: Large group report back
- Share 1-3 examples with the large group.
Federal Regulations Fail to Protect Us

The 1976 Toxic Substances Control Act (TSCA), as chemicals policy, has failed to sufficiently protect human health and the environment. The health, safety, and environmental effects of the great majority of some 80,000 industrial chemicals in commercial use in the U.S. are largely unknown.

- The TSCA does not require producers to provide information about the hazards of their chemicals or products.

- Sixty-two thousand chemicals were grandfathered without further review of their hazards by the TSCA.

- Ninety-two percent of the highest production volume chemicals in use today consist of these substances.

All federal statutes combined regulate only about one thousand chemicals and pollutants.
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Activity One – Task 1

Scope of the Problem: Fact Sheet 2

U.S. Chemicals Circle the World Eighty-Six Times

Each day, a total of 42 billion pounds of chemical substances are produced or imported in the U.S. for commercial and industrial uses.

An additional 1,000 new chemicals are introduced into commerce each year.

If converted to gallons they would fill 623,000 tanker trucks, which if placed back to back would circle the earth 86 times at the equator.
Activity One – Task 1

Scope of the Problem: Fact Sheet 3

Worker Health Suffers Severely Due to Chemical Exposure

Because many industrial processes involve exposure to hazardous substances, workers are disproportionately affected by chemically-caused diseases. Sixty percent of workplace chemicals suspected of causing cancer or reproductive harm are high production volume chemicals (produced or imported at more than one million pounds per year in the U.S.).

Estimates of the proportion of cancer that may be attributed to workplace exposures range from 5% to 20% and vary widely by cancer site. Each year from 2001 through 2005, an average of 35,280 work-related cancer cases were newly diagnosed in Massachusetts.

Nearly 500,000 adults in Massachusetts have asthma, and nationally, 15-30% of adults are estimated to have work-related asthma. More than 300 chemicals used in the workplace today can cause asthma. Much of this evidence comes from workers exposed on the job.
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Activity One – Task 1

Scope of the Problem: Fact Sheet 4

Two Hundred and Seventeen Thousand New Hazardous Waste Sites in the Next Twenty-Five Years

The number of hazardous waste sites in the United States continues to rise.

The U.S. EPA estimates that the country will require 217,000 new hazardous waste sites by 2033, a 180% increase over today’s 77,000 existing sites.

Each year, more than $1 billion is spent on efforts to clean up hazardous waste Superfund sites.

Cleanup costs for future sites are estimated at about $250 billion.
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Endocrine-Disrupting Chemicals Damage Children’s Development

Certain synthetic chemicals commonly found in consumer products can disrupt the endocrine system, a complex network of hormones that affect the development of all organs in the human body.

Even small alterations in hormone levels by endocrine-disrupting chemicals (EDCs) can affect development of the body’s neurological, reproductive and metabolic systems. These can produce permanent changes, affecting the body’s responses to food, chemicals and hormones even later in life.

This reprogramming may contribute to:

- Obesity
- Pre-diabetic insulin resistance
- Breast and prostate cancers

It is estimated that up to four future generations in a family may be affected by these changes.
Activity One – Task 1

Scope of the Problem: Fact Sheet 6
State of Protection: Data, Safety and Technology Gaps

**Data Gap:** Manufacturers and businesses can sell a chemical or product without generating or disclosing adequate information about its potential health or environmental hazards.

**Safety Gap:** Producers are not currently required to assume full responsibility for the health effects and environmental consequences that can occur over the lifecycle of their products.

**The Technology Gap:** The transition from a concept to a commercial application of sustainable chemistry requires that a company conduct extensive research and development, make potentially large capital investments and assume the risks of being a leader in an emerging field.

As a result of these gaps:
- The health effects of most chemicals are poorly understood.
- Hazardous chemicals and products remain cheaper to produce.
- The costs of health and environmental damage are carried by workers and the public.
- There is minimal industry investment in new technology.
- Government regulation does not adequately protect the public.
- There is virtually no attention given to sustainable chemistry education.
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ACTIVITY TWO

GREEN CHEMISTRY IN ACTION: MAKING GLUE

Time: 45 minutes total

An Introduction to the Twelve Principles of Green Chemistry

Trainers note: for more detailed trainer notes see the Worker and Environmentalist Green Chemistry Awareness Training Curriculum, Appendix A, Activity Two.

Purpose: To introduce the 12 Principles of Green Chemistry by experiencing the wasteful and non-environmentally friendly ways we have traditionally designed chemicals and products. Review the Hierarchies for Preventing Pollution and Workplace Illness, Injuries and Fatalities.

Objectives:
- Think critically about a chemical process for making glue and how it might be improved
- Understand what the process tells us about the underlying basic twelve green chemistry principles and safer alternatives
- Re-examine the familiar frameworks for environmental health and safety: Hierarchies for Preventing Pollution and Workplace Illness, Injuries and Fatalities

This activity has 3 tasks. The trainer will tell you when it is time to do each task in this activity.

Task 1: Making Glue: 15 minutes
- Worksheet 1: Working in teams, you will be assigned a process step to follow in order to help make the glue. Note: follow the instructions exactly. Each group will be asked to come to the front of the room and follow their numbered step. By the end of the process, the group will have made glue.
**Task 2:** Revising the Glue Making Process: *15 minutes*
- **Worksheet 2:** Rewrite your step with your group. You will be asked to share your revised step with the class. Make note of why you revised the step and how it helps make the process more efficient or less wasteful.
- Report back to large group.

**Task 3:** Reviewing posters: *15 minutes*
Review and discuss two posters: 12 Green Chemistry Principles and Hierarchies for Preventing Pollution and Workplace Illness, Injuries and Fatalities.
- **Discussion Questions:**
  1. How can the green chemistry principles be used for pollution prevention and workplace health and safety?
  2. How would you use this in your workplace or community?
Activity Two
Green Chemistry in Action: Making Glue

Task #1: Making Glue
Worksheet 1

Materials needed for this task:
- ½ gallon of milk
- 1 container of vinegar
- 1 can of beets
- Can opener
- 1 small pan
- 3 bowls
- 1 plate
- Pair of tongs
- Measuring cup
- Measuring spoons (1 tablespoon, 1 teaspoon)
- 1 spoon
- 1 cheesecloth or strainer
- Bleach wipes
- 1 hot plate
- 1 container of baking soda
- 1 knife (butter knife)

Method:
1. Set hot plate on low and place on a flat surface close to the gallon of milk. Measure 1 cup of milk and pour it into the pan. Place the remaining milk in the pile to be discarded.
2. Open the can of beets and pour them into a bowl. Select four beet slices and place them in the milk. Place the remaining beets in the pile to be discarded.
3. Swirl the beets and milk mixture with a spoon while your partner pretends to hula-hoop with the rhythm of swirling. Keep this up for 30 seconds.
4. Remove the beets from the milk with the tongs and set them on the plate. Cut the beets into ½ inch cubes. Place the plate of beets in the pile to be discarded.
5. Measure 4 tablespoons of vinegar into the milk. Stir with a spoon for 1 minute while your partner says the alphabet backwards.
6. Place the cheesecloth over a clean bowl. Slowly pour the milk mixture into the cheesecloth-covered bowl while your partner is holding the cheesecloth in place. Fold the cheesecloth up and gently squeeze the liquid out of the cheesecloth. Scrape the clump you have left into an empty bowl.

7. Open the container of baking soda. Add 4 pinches of baking soda and stir well. Place the remaining baking soda in the pile to be discarded.

8. Clean up the area with a bleach wipe. Do two jumping jacks and one push-up.

9. Use the glue to make a stick figure of your instructor. Remember to turn off the hot plate.
Activity Two  
Green Chemistry in Action: Making Glue 

Task #2: Revised Glue Making Instructions 
Worksheet 2 

Rewrite the process. Remember to think of all the things that would help to make the process easier, less wasteful, and less hazardous. 

**Method:** 
1. 

2. 

3. 

4. 

5. 

6.
12 Green Chemistry Principles – In Action

**Raw Materials and Feedstocks:**
- Atom Economy (2)
- Renewable Feedstocks (7)

**Processing Chemicals:**
- Reduce Hazardous Processes (3)
- Energy Efficiency (6)
- Safer Solvents (5)
- Reduce Derivatives (8)
- Catalysis (9)
- Real-Time Analysis (11)
- Accident Prevention (12)

**The Product:**
- Designing Safer Products (4)

**End-of-Life:**
- Recycle (1)
- Reuse (1)
- Regeneration (1)
- Compost/Biodegradable (10)
- Landfill (Pollution)

**Pollution to Avoid:**
- By-Products
- Unused Reagents and Raw Materials
- Spent Solvent
- Wasted Energy

**Pollution Prevention:**
- Reduce By-Product Formation (2)(8)
- Use Less/Safer Reagents and Raw Materials (3)
- Use Less/Safer Solvents (5)
- Reduce Energy Use (6)
- More Efficient Processes (9)
## Activity Two – Fact Sheet
### The Twelve Principles of Green Chemistry

1. **Prevention (Waste).** It is better to prevent waste than to treat or clean up waste after it is formed.

2. **Atom Economy.** Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.

3. **Less Hazardous Chemical Synthesis.** Whenever practicable, synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and the environment.

4. **Designing Safer Chemicals.** Chemical products should be designed to preserve efficacy of the function while reducing toxicity.

5. **Safer Solvents and Auxiliaries.** The use of auxiliary substances (solvents, separation agents, etc.) should be made unnecessary whenever possible and, when used, innocuous.

6. **Design for Energy Efficiency.** Energy requirements should be recognized for their environmental and economic impacts and should be minimized. Synthetic methods should be conducted at ambient temperature and pressure.

7. **Use of Renewable Feedstocks.** A raw material or feedstock should be renewable rather than depleting whenever technically and economically practical.

8. **Reduce Derivatives.** Unnecessary derivatization (blocking group, protection/deprotection, temporary modification of physical/chemical processes) should be avoided whenever possible.

9. **Catalysis.** Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.

10. **Design for Degradation.** Chemical products should be designed so that at the end of their function they do not persist in the environment and instead break down into innocuous degradation products.

11. **Real-time Analysis for Pollution Prevention.** Analytical methodologies need to be further developed to allow for real-time in-process monitoring and control prior to the formation of hazardous substances.

12. **Inherently Safer Chemistry for Accident Prevention.** Substance and the form of a substance used in a chemical process should be chosen so as to minimize the potential for chemical accidents, including releases, explosions, and fires.

Hierarchies for Preventing Pollution and Workplace Illnesses, Injuries, and Fatalities

**Pollution Prevention: P2**

- Eliminate or Reduce toxic substances and processes
  - Change the product; change the process; substitute non-toxic for toxic.
- Reduce exposure to toxic substances by "control at the source"
  - Closed loop systems; isolation / total enclosure; process redesign
- Recycling: Processing waste for reuse

**Workplace Health & Safety: H & S**

- Eliminate Hazards
  - Substitute toxic and hazardous chemicals with safe or less toxic / hazardous chemicals
- Engineering Controls
  - Redesign process or job tasks; Use appropriate ventilation; enclose / isolate process
- Administrative Controls
  - H&S Committees; work organization; policies, practices; housekeeping & maintenance; training; medical monitoring
- Personal Protective Equipment
  - Respiratory protection, goggles; skin protection (gloves, suit, boots)

**Least Effective for H & S and P2**

- Treatment: Only if necessary – burning or using biological and/or chemical methods
- Storage and Disposal: Responsible storage / disposal of unavoidable waste – taking strong measures to prevent contamination

**Best H & S and P2 for Chemicals**

- Reduce exposure to toxic substances by "control at the source"
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ACTIVITY THREE
WEATHERIZATION AND GREEN CHEMISTRY:
HOW TO MAKE OUR HOMES AND OUR JOBS SAFER

Time: 60 minutes total

Purpose: In this activity participants will:

- identify the health and safety hazards of tasks involved in weatherizing a building
- develop some recommendations using a “green chemistry” approach to toxics and worker hazards for the Green Justice Coalition

5 minutes Re-introduce “What Makes A Job Green? The Four G’s” handout

Trainer note: We will focus on the “green lungs”/workplace environment in this section.

5 minutes What is the purpose of weatherization? What are the job tasks involved in this work? Review job tasks for weatherization (on worksheet)

In small groups look at packet of pictures and:

10 minutes Identify hazards that reflect the weatherization tasks; report out to large group

10 minutes Discuss any health and safety hazards, and any health effects for residents or weatherization workers for those hazards; report out to large group

20 minutes Taking Action: Look at the “What Makes a Job Green? The Four G’s” handout again. Record actions on flip chart.

10 minutes Evaluation

Trainer notes: Hazard examples from weatherization pictures:

- lead paint; asbestos; PBCs in caulking; spray foam insulation; carbon monoxide from broken vent in boiler; mold; frayed wires/electrical fire or
shock; dust; working in confined spaces; ladder safety/falls; heat, discomfort and poorly fitting protective equipment (gloves, goggles, Tyvek suits, respirators).

Additional information on health effects, if needed:

- **Toxic materials**
  - Lead (affects reproductive health, triggers nerve and stomach disorders, causes learning disabilities).
  - Asbestos (causes lung disease).
  - PCB’s in caulking (affects hormones and organ systems).

These are examples of substances that were successful for their purpose (durable paint, fireproof insulation, pliable caulking). These substances were used without regard for worker and community health. Now we have a legacy of contamination and disease.

- **Carbon monoxide**: is an odorless, tasteless, colorless and toxic gas. Carbon monoxide is produced as a by-product of combustion and can be released from broken vents in boilers. It inhibits the blood's ability to carry oxygen to vital organs such as the heart and brain.

- **Mold**: Allergies and asthma. Some researchers believe more serious effects may result from mold exposure, including fever, flu-like symptoms, fatigue, respiratory dysfunction (including coughing-up blood), frequent and excessive nose bleeds, dizziness, headaches, diarrhea, vomiting, and liver damage. Such symptoms may disappear when exposure to mold no longer exists. Other health problems may be permanent.

- **Spray foam insulation (polyurethane)**: flammable; many contain Isocyanates are the leading cause of workplace-related asthma and pulmonary disorders. This product is a good candidate for applying the green chemistry principles to get a safer product.

- **Inhalation**: breathing dusts and/or spores can cause asthma and allergies or make them worse, or can expose workers to known toxins such as lead, asbestos, etc.
- **Electrical injuries:** frayed wires can cause fatal electrical fires, shocks, or electrocution.

- **Falling injuries:** ladders, roofs, stairs, scaffolding and other elevated surfaces can be dangerous. Falls from these, or from holes in flooring, can lead to serious injuries and/or death.

- **Back injuries, sprains, and strains:** working in awkward positions and spaces, heavy lifting, and poorly-designed tools can lead to injury.

- **Confined spaces:** A closed environment may contain a hazardous atmosphere that could lead to serious injury or death from asphyxiation, fire, or explosion.

- **Other working-condition hazards:**
  - Heat
  - Poorly-fitting protective equipment (gloves, goggles, Tyvek suits, respirators)

Some suggested questions:

- What do we need to do to make this work safe?
- What leverage or pressure points would help to ensure safety?
- Are there any action items that would include using some of the green chemistry principles?
- What do we want to report back to our union/coalition/community group about what we discussed tonight?

**Points to add if needed:**

- Advocate for safer products and green chemistry/toxics use reduction strategies
- Find out what spray foam products local weatherization contractors are using
- Investigate use of laws and regulations (lead, asbestos; OSHA, EPA, State DOL)
- Promote standards or best practices developed by industry or third-party standards development organizations—for example, ASHRAE, ASTM, the Building Performance Institute
• Make sure training programs include environmental safety and health (certification and union jobs)
• Promote “responsible contractor” language
• Include EHS in community mobilization for programs that provide home weatherization
Activity 3 – Worksheet 1

Weatherization work should be safe and healthy for workers and residents

What is weatherization? It modifies our homes (or a building) to reduce energy use and create energy efficiency by:

- Installing modern, energy-saving heating and cooling equipment (programmable thermostats, energy-efficient appliances)
- Sealing cracks, gaps, and holes, especially around doors, windows, pipes
- Protecting pipes from corrosion and freezing
- Installing roofing, building wrap, siding, foundations, skylights or/and making sure they are in good condition on an existing building
- Installing insulation in walls, floors, ceilings, ducts and pipes

In your small group:

1. Identify any hazards you see in these pictures and for weatherization tasks.
2. Discuss health problems that may come from the hazards.
3. Have someone in your group take notes for the report-back.
Activity 3: Weatherization Photos

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Activity 3: Weatherization Photos

Appendix C-40