Students, too, can be involved in indoor air quality monitoring. Science club students in one Spokane-area school successfully conducted routine indoor air quality testing, referring problems they found to the facilities staff.

Gail Gensler

Here are some highlights of the new resource guide: Improving Indoor Air Quality in King County Schools.

According to a report from the Environmental Protection Agency, indoor air quality problems can increase absences because of respiratory infections, allergic diseases from biological contaminants, or adverse reactions to chemicals used in school. The report cites research that shows a link between decreased ventilation levels and decreased student concentration and performance.

Improving the indoor air quality in your school can help:

- decrease illness rates
- decrease absenteeism, and
- improve students’ academic performance

School districts, maintenance staff, teachers, and the rest of a school community can improve the school’s indoor air quality by following these three steps.

1. Keep your building dry and clean.
2. Control pollutants.
3. Ventilate adequately.

See King County on page 6
What is the RCM Exchange?

By Karen Messmer, WSU Extension Energy Program

RCM Exchange (RCMx) is an interactive online resource for Resource Conservation Managers (RCMs). The Guide to Success in operating an RCM program includes checklists, sample reports, and other nuts-and-bolts resources. All materials are provided in electronic format to allow easy customization and sharing.

RCMx also provides Tip Sheets & Tools, Success Stories, Profiles of RCMs, and Networking opportunities such as meetings and electronic forums. RCMs are encouraged to recommend additional resources they’ve found helpful. The idea behind RCMx is to let this online resource evolve through the collective wisdom of your individual experiences.


You can also sign up for our monthly RCM newsletter summarizing articles and providing event announcements and references to useful resources. To subscribe, contact Karen Messmer: messmerk@energy.wsu.edu

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WSUEEP-09-016 • April 2009
Collaborative for High Performance Schools: Who, What and How

The mission of the Collaborative for High Performance Schools (CHPS) is to facilitate the design, construction and operation of high performance schools: environments that are not only energy and resource efficient, but also healthy, comfortable, well lit, and containing the amenities for a quality education.

Schools and School Districts:
CHPS is now offering free membership to schools and districts through the CHPS Registered program. To learn more and to apply, go to www.chps.net/membership/index.htm

CHPS helps facilitate and inspire change in our educational system. The goals of CHPS are to:
- Increase student performance with better-designed and healthier facilities,
- Raise awareness of the impact and advantages of high performance schools,
- Provide professionals with better tools to facilitate effective design, construction and maintenance of high performance schools,
- Increase school energy and resource efficiency, and
- Reduce peak electric loads.

CHPS Programs:
High Performance School Recognition and Rating Programs
CHPS oversees the nation’s first green building rating program especially designed for K-12 schools. The CHPS Criteria is a comprehensive system of environmentally responsible benchmarks designed by the CHPS technical committee, which is made up of over fifty school facilities experts including state agency officials, designers, school district officials, contractors, product manufacturers and energy and water utility officials. A CHPS school is a school that has strived to achieve excellence in environmental efficiency and healthy building practices. CHPS recognizes superior design teams and school districts through award ceremonies, case studies and media outreach. Schools can self-certify their school through the free CHPS Designed program, or seek third-party verification of their high performance school through the CHPS Verified program.

High Performance School Trainings
CHPS, an American Institute of Architects registered provider of Continuing Education Services, offers accredited high performance school technical seminars to design professionals. A leader in the field of green school development, CHPS also offers workshops to school districts and other stakeholders on the green school development process, including assisting school districts in creating district-wide resolutions on green school construction. CHPS also offers an annual conference on high performance schools called Greentools for Healthy Schools.

CHPS Best Practice Manual
CHPS has developed and maintains a six-volume technical best practices manual for high performance schools. The manual covers planning, design, high performance benchmarks, maintenance and operations, commissioning and relocatable classrooms in high performance schools. The manual was developed through a consensus process with the assistance of school officials, state agencies, industry representatives and design professionals. CHPS periodically updates each volume of the manual.

CHPS High Performance Resources
CHPS manages a member directory of green school building services and products and a directory of certified low emitting materials for green school construction. CHPS also offers online trainings and presentations, specifications and informational fact sheets. CHPS is developing an individual professional accreditation program that will allow design

See CHPS on page 8
Are Your School’s Vacuums Capturing Particles?
By Rich Prill, WSU Extension Energy Program

As I visit NW schools to assist with indoor air quality assessments and program implementations I always bring along my particle counter. Airborne particles can obviously have a significant impact on our school occupants, so the goal should be “prudent avoidance” to the extent practical. The trouble is the small particles of primary concern are too small to be visible to the naked eye. That’s where the particle counter is useful – it “sees” the particles we cannot. Plus the instrument provides numbers that help you understand your HVAC filter effectiveness (indoor vs outdoor particle counts), as well as comparing various rooms and zones to one another. When indoor concentrations are higher than outdoors, it’s clear the source is indoors. Identifying zones with higher particle counts allows you to focus your control strategies and cleaning efforts and compare before-and-after particle counts to ensure your efforts are effective.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>0.3</th>
<th>0.5</th>
<th>1.0</th>
<th>2.0</th>
<th>5.0</th>
<th>10.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back-pack 62-076757 (very clean filters)</td>
<td>47,748</td>
<td>5153</td>
<td>510</td>
<td>186</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Back-pack 12579 (Dirty filters)</td>
<td>103,501</td>
<td>23539</td>
<td>5736</td>
<td>3230</td>
<td>506</td>
<td>109</td>
</tr>
<tr>
<td>Back-pack 12579 (Clean filters including hepa)</td>
<td>85,948</td>
<td>13948</td>
<td>2528</td>
<td>1493</td>
<td>401</td>
<td>120</td>
</tr>
<tr>
<td>Back-pack vacuum ID: 0116891 FXR &quot;with dirty filter&quot;</td>
<td>99,886</td>
<td>15819</td>
<td>1746</td>
<td>932</td>
<td>30</td>
<td>14</td>
</tr>
<tr>
<td>Back-pack vacuum ID: 0116891 FXR &quot;with a clean hepa filter&quot;</td>
<td>77,284</td>
<td>20902</td>
<td>3649</td>
<td>3278</td>
<td>651</td>
<td>196</td>
</tr>
<tr>
<td>Back-pack vacuum ID: 0117640 FXR &quot;with dirty filter&quot;</td>
<td>117,061</td>
<td>22666</td>
<td>1900</td>
<td>1026</td>
<td>71</td>
<td>16</td>
</tr>
<tr>
<td>Back-pack vacuum ID: 0117640 FXR &quot;with a clean hepa filter&quot;</td>
<td>93,133</td>
<td>13755</td>
<td>868</td>
<td>417</td>
<td>41</td>
<td>6</td>
</tr>
<tr>
<td>Back-pack vacuum cleaner #0116890 FXR dirty filter</td>
<td>281,750</td>
<td>67464</td>
<td>12918</td>
<td>6472</td>
<td>1707</td>
<td>995</td>
</tr>
<tr>
<td>Back-pack vacuum cleaner #0116890 FXR new filter</td>
<td>248,656</td>
<td>54535</td>
<td>13063</td>
<td>7259</td>
<td>1205</td>
<td>182</td>
</tr>
<tr>
<td>Back-pack 0116789 FXR (Dirty filters)</td>
<td>54,144</td>
<td>10971</td>
<td>1538</td>
<td>632</td>
<td>39</td>
<td>6</td>
</tr>
<tr>
<td>Back-pack 0116789 FXR (Clean filters)</td>
<td>40,701</td>
<td>8009</td>
<td>1247</td>
<td>571</td>
<td>73</td>
<td>16</td>
</tr>
<tr>
<td>Back-pack 0116788 FXR (Dirty filters)</td>
<td>24,482</td>
<td>3768</td>
<td>651</td>
<td>337</td>
<td>53</td>
<td>8</td>
</tr>
<tr>
<td>Back-pack 130822 (Dirty filters)</td>
<td>50,725</td>
<td>17418</td>
<td>4888</td>
<td>2491</td>
<td>316</td>
<td>69</td>
</tr>
<tr>
<td>Back-pack 130822 (Clean filters)</td>
<td>35,820</td>
<td>9391</td>
<td>2590</td>
<td>1290</td>
<td>171</td>
<td>29</td>
</tr>
<tr>
<td>Old Royal Vacuum Cleaner (rarely used)</td>
<td>19,518</td>
<td>4085</td>
<td>2580</td>
<td>2141</td>
<td>889</td>
<td>261</td>
</tr>
<tr>
<td>Back-pack 62-074935 (Dirty filters)</td>
<td>48,963</td>
<td>12401</td>
<td>3386</td>
<td>1996</td>
<td>662</td>
<td>223</td>
</tr>
<tr>
<td>Back-pack 62-074935 (Clean filters)</td>
<td>57,299</td>
<td>13846</td>
<td>3816</td>
<td>2317</td>
<td>661</td>
<td>167</td>
</tr>
<tr>
<td>Back-pack 62-034055 (Dirty filters)</td>
<td>53,213</td>
<td>14326</td>
<td>4016</td>
<td>2435</td>
<td>596</td>
<td>111</td>
</tr>
<tr>
<td>Back-pack 62-034055 (Clean filters)</td>
<td>58,022</td>
<td>15043</td>
<td>4281</td>
<td>2619</td>
<td>611</td>
<td>133</td>
</tr>
<tr>
<td>Back-pack #184163 (dirty filters)</td>
<td>149,427</td>
<td>23263</td>
<td>4385</td>
<td>2053</td>
<td>330</td>
<td>65</td>
</tr>
<tr>
<td>Back-pack #184163 (new filters)</td>
<td>88,125</td>
<td>15372</td>
<td>3655</td>
<td>1985</td>
<td>257</td>
<td>37</td>
</tr>
<tr>
<td>Up-right Windsor #131146 (very clean filter)</td>
<td>90,437</td>
<td>11513</td>
<td>1329</td>
<td>682</td>
<td>176</td>
<td>72</td>
</tr>
</tbody>
</table>
Another use of the particle counter is to check vacuum filtering effectiveness. I’ve measured particles being sprayed out of shiny new and expensive vacuums, old worn units, and equipment with “high efficiency HEPA filtration.”

Unfortunately, in my experience, I am unable to predict how well a particular vacuum is capturing particles by brand, type, filter or bag type, age, appearance, or by what’s written on the unit (e.g., Binford Premium Super Deluxe Maxi-Stage Eco Filtration XL Magnum Pro). The only way to know for sure how this equipment is working is to measure the particulates in the exhaust stream.

The time it takes for the smallest particles to settle out of the air is on the order of days, not minutes or hours. So using a vacuum with poor capture ability for a couple of hours in the evening can mean increased exposures the next school day. Plus, your custodians are taking the brunt of the exposure on a daily basis.

Take a look back at the Fall 2008 issue of this IAQ newsletter “Vacuum Cleaners and Suspended Particles in Homes and Schools” by Dave Blake: http://www.energy.wsu.edu/documents/building/iaq/nl/08_fall_iaq_nl.pdf.

The Bellingham School District (National Tools for Schools IAQ Award Winner) took the initiative to check a number of their vacuums. Chris Dean, BSD Custodial Supervisor conducted the testing (360-676-6544) and Dave Blake, Northwest Clean Air Agency, loaned the particle counter. I’ve summarized – with BSD’s blessing – the results of these tests in the table on page 4.

Many factors can influence the performance of an individual piece of equipment. Note that we make no claims as to the scientific validity of these values nor should these results be interpreted as an endorsement or discredit of a particular type or brand of equipment. Your particular up-right or back-pack or “pig” vacuum performance may differ substantially. A thorough study would be useful in order to provide schools and others with clear and useful guidance.

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**Results From Other School District Vacuums**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>0.3</th>
<th>0.5</th>
<th>1.0</th>
<th>2.0</th>
<th>5.0</th>
<th>10.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up-right (dirty filter)</td>
<td>74,000</td>
<td>24,000</td>
<td>4,700</td>
<td>4,500</td>
<td>267</td>
<td>55</td>
</tr>
<tr>
<td>Up-right (dirty filter)</td>
<td>143,000</td>
<td>23,000</td>
<td>1,700</td>
<td>2,000</td>
<td>600</td>
<td>300</td>
</tr>
<tr>
<td>Back-pack (dirty filter)</td>
<td>101,000</td>
<td>25,000</td>
<td>2,200</td>
<td>736</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Up-right (dirty filter)</td>
<td>29,000</td>
<td>4,200</td>
<td>480</td>
<td>460</td>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>Up-right (dirty filter)</td>
<td>42,000</td>
<td>9,500</td>
<td>1,000</td>
<td>589</td>
<td>250</td>
<td>345</td>
</tr>
<tr>
<td>Back-pack (dirty filter)</td>
<td>70,690</td>
<td>20,600</td>
<td>2,900</td>
<td>2,000</td>
<td>393</td>
<td>230</td>
</tr>
<tr>
<td>Up-right (old) (dirty filter)</td>
<td>45,000</td>
<td>20,000</td>
<td>5,000</td>
<td>6,000</td>
<td>1,000</td>
<td>400</td>
</tr>
<tr>
<td>&quot;Pig&quot; (dirty filter)</td>
<td>1,800</td>
<td>300</td>
<td>100</td>
<td>375</td>
<td>550</td>
<td>590</td>
</tr>
<tr>
<td>Up-right Windsor (dirty filter)</td>
<td>120,000</td>
<td>38,000</td>
<td>3,300</td>
<td>1,000</td>
<td>160</td>
<td>110</td>
</tr>
<tr>
<td>Hoover Wind-Tunnel Up-Right (residential model)</td>
<td>4,900</td>
<td>170</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Up-right Windsor (dirty filter)</td>
<td>81,000</td>
<td>20,000</td>
<td>1,500</td>
<td>530</td>
<td>52</td>
<td>68</td>
</tr>
<tr>
<td>Back-pack (dirty filter)</td>
<td>47,000</td>
<td>10,000</td>
<td>1,000</td>
<td>700</td>
<td>160</td>
<td>160</td>
</tr>
</tbody>
</table>

*Note 1: Some rounding of values was performed*

*Note 2: "Dirty filter" means the unit was operated as-found with the used filter/bag in place*
If options are limited, take these priority actions:

- Minimize the amount of dust and dirt tracked in.
- Avoid allergens and asthma triggers.
- Make sure that building heating, ventilation, air-conditioning (HVAC) systems meet the standards.


I. Keep your building dry and clean

1. Get rid of mold. Mold can trigger allergies. If you see or smell mold or mildew, there’s probably a water or moisture problem. Find the mold and remove it. Dry up the source of the water to prevent more molds from growing.

2. Minimize the amount of dust and dirt tracked indoors.
   - Keep pesticides, herbicides, grit, dirt and other outdoor pollutants outside the building.

**Maintenance staff:**
1. Stop dirt and toxic pollutants at the door. Place walk-off mats inside each entrance (preferably as wide as the doorway and twice as long, often 6’x12’).
2. If possible, also have walk-off mats outside entrances to capture dirt, mud, water, and snow.
3. Clean walk-off mats regularly.

3. Keep the inside space as clean as possible.

**Maintenance staff:**
1. On existing vacuum cleaners, replace dust bags with double-layered or other higher efficiency filter bags.
2. When purchasing new vacuums, choose “true HEPA” or “sealed HEPA” models.
3. Vacuum thoroughly and deeply every day, make sure that every room gets a thorough and deep vacuuming at least once a week.
4. For carpet cleaning, use hot water carpet extraction only – soaps and detergents leave a residue that will become airborne when dry and expose occupants to these chemicals.

**Teachers and students:**
Place chairs on top of desks and tables at the end of the day to help give custodians more time to clean and better access to carpet and floor areas.

II. Control pollutants

1. Avoid allergens and asthma triggers. Asthma is the leading cause of school absenteeism from a chronic childhood condition. Thirteen million school days are missed each year due to asthma, and an average of one out of every 13 school-aged children has asthma.

Reduce exposure to these asthma triggers:

- dust mites
- molds
- cockroaches
- pet dander
- fumes and fragrances
- chemicals
- dust
- products of combustion

**Maintenance staff:**
1. Eliminate the use of paradichlorobenzene urinal blocks and other air freshener products.
2. Many air fresheners work by adding toxic scents to the air, not by eliminating existing odors. For normal odors, flush fresh air through the heating, ventilating and cooling system or open windows.
3. Reduce or eliminate the use of fragrances in the school, particularly air fresheners. Fragrances may be allergy triggers.

Continued on next page
King County

Continued from page 6

Teachers:
1. Avoid or remove fabric and fleece materials such as upholstered furniture, blankets, area rugs, pillows and stuffed animals/toys from the classroom. They can gather dust, dander, fragrance and other asthma and allergy triggers.
3. Use only low odor dry erase markers and keep use to a minimum.

2. Keep carbon monoxide levels down.

Maintenance staff:
1. Place carbon monoxide alarms in areas of the school with combustion equipment (boilers, furnaces, water heaters, etc.). Carbon monoxide is colorless and odorless. Low level concentrations can cause fatigue, headaches and dizziness depending on the length of exposure. High levels can be deadly.

III. Ventilate adequately

1. Maintain a healthy air flow.

District:
1. Prohibit air cleaners that emit ozone, either intentionally, or as a by-product. Ozone is a respiratory irritant that can severely aggravate asthma and respiratory conditions.
2. Institute a “no idling close to school” policy for all vehicles., see http://your.kingcounty.gov/solidwaste/greenschools/transportation-resources.asp.
3. Invest in basic indoor air quality monitoring equipment to allow operations and maintenance staff to make routine checks as well as respond promptly to concerns.

The equipment should check the following:
- Carbon dioxide
- Carbon monoxide
- Moisture
- Air flow direction
- Temperature
- Relative humidity

A basic set of equipment will cost around $1,000.

Maintenance staff:
1. Make sure that building heating, ventilation, air-conditioning (HVAC) systems meet the following standards. Standards generally measure the amount of carbon dioxide in a room.
   - The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 62, recommends that indoor CO₂ levels should be no more than 700 parts per million above outdoor, background levels (typically around 300-400 parts per million). This results in an indoor CO₂ limit of approximately 1,000 parts per million.
   - Chapter 51-13, Washington Administrative Code requires 15-20 cubic ft./minute of fresh air intake in school buildings.
2. Maintain and inspect HVAC systems as prescribed by the manufacturer.
3. Ensure HVAC filters are clean and tight fitting, and the HVAC systems are clean and free of moisture, molds, deteriorating linings, and other contaminants. Mold indicates a moisture problem, so fix leaks promptly and keep the whole school building dry and clean.
4. Change ventilation system filters at least three times a year; write the change date on the filter, and maintain a logbook recording changes. Assure filters fit tightly and cannot be bypassed.
5. Ventilate exhaust fumes from labs, art classes, photocopy machine spaces, auto shop spaces and other shop spaces directly to the outside of a building.

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King County
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**Teachers:**
1. Keep classroom ventilator units unobstructed. Do not store teaching materials, student projects, or plants on them.
2. If ventilation systems are controlled by basic thermostats in the rooms, set the thermostat to “FAN ON” during occupied hours and to “AUTO” when you leave.
3. If the existing ventilation system does not provide sufficient fresh air, open windows for a few minutes every hour to flush out the room.

III. **Provide education**

1. Adopt an indoor air quality plan for the district.
2. Provide training to key school district professionals to become CHPS-accredited.
3. Students, too, can be involved in indoor air quality monitoring. For example, science club students in one Spokane-area school successfully conducted routine indoor air quality testing, referring problems they found to the facilities staff.
4. Raise awareness among all school district staff and students about the importance of preventing exposure to indoor air pollutants.

Follow this link to the full resource guide: http://www.govlink.org/hazwaste/publications/index.cfm#2180

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**CHPS**
Continued from page 3

professionals to become CHPS-accredited.

For further information, contact CHPS at 142 Minna St., Second Floor, San Francisco, CA 94105; call them at 415-957-9888; or email info@chps.net

**Washington State CHPS**
The Washington Sustainable Schools Protocol is the state’s benchmark for design and construction of high performance schools. The Protocol is based on the CHPS Criteria, and was a result of a three-year long pilot program during which it was decided that CHPS was the best high performance building program for the state. The Protocol was developed out of the CHPS program.

All major facility projects of public school districts receiving any funding in a state capital budget must be designed and constructed to the Washington Sustainable School Design Protocol or a LEED Silver Standard.

Recent recognized designed schools in Washington to have completed the CHPS program are:
- Washington Middle School, Olympia
- Chester H. Thompson Elementary School, Tacoma
- Cottage Lake Elementary, Woodinville
- Fern Hill School, Tacoma (above)
- Lincoln Heights Elementary, Spokane

For more information, contact the Washington State Office of Superintendent of Public Instruction:
Patricia Jatczak
High Performance School Building Coordinator
360-725-4973
Email: Patricia.jatczak@k12.wa.us