THE Kirksey Guide to a Green School

A working guidebook for operating your school more efficiently

Kirksey ARCHITECTURE

ARCHITECTURE / INTERIOR DESIGN / MASTER PLANNING / ECOSERVICES

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acknowledgements

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about this book

If you picked up this book, you are probably wondering if you can run your school in a more sustainable way. You may be plagued by doubts: Can it be done without spending a fortune? Can someone without a PhD in environmental engineering understand it? Can it be done without completely changing your organization and culture?

In a word, *yes!*

We wrote this book to get you started. It's a simple guide with straightforward recommendations that almost any school can employ.

Greening your school doesn't have to be…

costly. This book is full of ideas that will cost you nothing or save you money. There are even some ideas that will do both!

complicated. Much of what we suggest is just plain common sense.

disruptive. You can start with small steps and build up.

Adopting green does require commitment, a willingness to look critically at the way your school is run, and a willingness to change. That may not be easy, but it is an effort that will pay for itself bountifully in better health, greater productivity, lower maintenance, lower energy costs, and increased goodwill.

Many schools have gone green, and yours can, too!

The Kirksey Guide to a Green School

table of contents

ENERGY

According to the EPA, our nation's 17,450 K-12 school districts spend more than $6 billion annually on energy ***— more than is spent on computers and textbooks combined.*** As much as 30 percent of a district's total energy is used inefficiently or unnecessarily.

Facing Page: Texas Woman's University
Institute of Health Sciences

energy at a glance

- ☑ Don't over light your space.
- ☑ Purchase efficient light bulbs.
- ☑ Purchase low-mercury fluorescent bulbs.
- ☑ Properly maintain lighting fixtures.
- ☑ Install occupancy and lighting controls.
- ☑ Properly maintain HVAC systems.
- ☑ Have your building retro-commissioned.
- ☑ Turn off computers at the end of the day.
- ☑ Purchase flat-screen monitors.
- ☑ Install window film.
- ☑ Install CO_2 monitors.
- ☑ Install energy-efficient kitchen equipment and appliances.

Interior Lighting

Lighting improvements are often the most cost-effective way to conserve energy.

Perform a lighting audit to check if lighting levels in your school are appropriate.

- Measure light levels with a light meter.
- Compare them to IESNA standards for interior lighting.

IESNA RECOMMENDED LIGHT LEVELS

Task and Area Description	Footcandles
Public spaces (where reading is rarely performed)	3
Spaces with simple signage	5
Working spaces where occasional, simple visual tasks are performed (Lobbies, Reception Areas)	10
Working spaces where visual tasks of high contrast and large size are performed. Good ambient lighting level for offices with task lighting (Photocopy Rooms, Machine Rooms)	30
Working spaces where visual tasks of either low contrast or small size are performed (Classrooms, Filing Areas, Typical Offices)	50
Working spaces where visual tasks of both low contrast and small size are performed (Specialty Classrooms, Accounting or Drafting Areas)	100

(source: IESNA Lighting Design Guide)

LAMP EFFICIENCIES

Product	Watts	Life (hours)	Color Rendering Index	Increased Efficiency	Payback
Incandescent	100	1,000	100	N/A	N/A
Compact Fluorescent	23	10,000	82-88	75% (over incandescent)	< 1 year (over incandescent)
T12	40	20,000	62	N/A	N/A
T12 (efficient)	34	20,000	62	N/A	N/A
T8	32	20,000	86	16% (over T12)	3 yrs (from T12)
T5	28	20,000	85	33% (over T12)	3-8 yrs (from T12)

(sources: EPA, California Energy Commission, Alan Whitson, United Illuminating Co., US Navy)

Replace incandescent bulbs and fixtures with fluorescent bulbs and fixtures.

- Implement a district-wide program to change from T-12 to T-8 lamps.
- Check that the new lamp's lumen output matches the tasks performed in the space and conforms to the fixture's specifications.
- If replacing ballasts in fluorescent fixtures, purchase improved electromagnetic ballasts or electronic ballasts. They will raise the efficiency of the fixture 12% to 30%.

Compact fluorescent bulbs use 75% less energy than a standard incandescent bulb and last up to 10 times longer.[1]

LIGHT LEVELS DECREASE

over time because of aging lamps and dirt on fixtures, lamps, and room surfaces. These factors can reduce total illumination by 50% or more, while lights continue drawing full power.[2]

RULES OF THUMB

FOR OCCUPANCY SENSORS

CLASSROOM / OFFICES: Specify wall-mounted sensors.

CLASSROOM / OPEN AREAS: Specify ceiling-mounted sensors.

BATHROOMS AND AUXILIARY SPACES: Specify wall-mounted sensors.

A STUDY by the Lighting Research Institute at Rensselaer Polytechnic Institute evaluated the National Center for Atmospheric Research's facility for lighting controls. It found that the lighting control system accounted for a 61% lighting energy savings, compared to an automatic control system with lights on 10 hours each day.[3]

Purchase fluorescent light bulbs with low mercury content, and make sure to dispose of mercury-containing lamps properly.

- All fluorescent bulbs contain mercury. They are considered Universal Waste and must be handled at an EPA-approved facility. They can either be recycled or disposed of at a hazardous waste landfill.

- Find more information and a list of lamp recyclers in your area at www.lamprecycle.org, a service of the National Electrical Manufacturers Association.

Maintain lighting fixtures properly.

- Wipe dust off fixtures, lamps, and lenses every 6 to 24 months.
- Replace lenses if they appear yellow.
- Consider group re-lamping. Incandescent and fluorescent lamps lose 20% to 30% of their light output over their service life.

Install occupancy and lighting controls.

Texas state code requires meeting or exceeding ASHRAE 90.1-2001 standards for energy efficiency, including lighting controls. These standards call for either time scheduling or occupancy sensors for all buildings 5,000 sf or more. To meet and go beyond code, we recommend the following:

- **Programmable time scheduling**
  These systems turn off or dim lights according to a schedule using digitally-controlled relay or dimming systems. In areas such as cafeterias or corridors where it won't be disruptive to work, enhance this system with photocells that can turn off banks of lights near windows.
- **Occupancy sensors**
  These turn lights off within a specified period after a space is vacated. However, best practice is to turn off lights when leaving a room.
- **Manual on**
  For both of the above strategies, specify that the system be manual on, auto off. This means that the system will not turn on unless someone flips the light switch. Once the light switch has been turned on, system will return to its regularly-scheduled mode—turning off after a set time, or when the system senses no occupants.

Low-Mercury Content Bulbs
Sylvania ECOLOGIC: www.sylvania.com
GE Ecolux: www.gelighting.com
Philips ALTO: www.lighting.philips.com

HVAC

Heating, Ventilation and Air Conditioning account for 40-60% of the energy used in US commercial buildings.

Have your school retro-commissioned to ensure that all systems are performing as they were designed.

Retro-commissioning (RCx) is a process of verifying that installed equipment is operating efficiently and is capable of providing the services necessary to meet the building occupants' needs. The RCx process addresses problems that lead to high energy and maintenance costs, occupant complaints, poor indoor environmental quality, and premature equipment failure.

ENERGY

- A building may be a candidate for RCx if it has:
  - An unjustified, high-energy use index (BTUs/square foot)
  - Persistent failure of building equipment, control systems or both
  - Excessive occupant complaints about comfort.

- RCx is not appropriate when:
  - Most of the equipment and systems are either outdated or at the end of their life
  - Major equipment malfunctions exist such that the best remedy is replacement.

RCx **costs** typically range from $0.10 to $0.50 per square foot. Costs vary depending on the complexity of systems and project goals.

QUALIFICATIONS FOR COMMISSIONING AGENTS

The California Commissioning Collaborative recommends looking for the following qualifications when selecting a building commissioner:

- Current technical knowledge and extensive recent hands-on field experience equal to that of a Professional Engineer, regarding:
  - Building System Commissioning, including design review, construction observation, system testing, and post-occupancy evaluations
  - Building system performance and interaction, with a focus on building automation control systems
  - Common installation, maintenance and operational pitfalls for commissioned systems
  - The building design and construction process
- Experience troubleshooting commissioned systems
- Provider for at least four (4) other commissioning projects of a similar nature
- Experience in related fields, such as design, construction, and building operations
- Good written, verbal, conflict resolution and organizational skills
- Excellent references and work products from similar commissioning projects

A US Department of Energy-funded study compiling data from 224 buildings concludes that retro-commissioning is cost-effective in terms of energy savings from improved equipment lifetimes, reduced maintenance, fewer contractor callbacks, and other non-energy benefits. Investigators found that existing buildings achieved median energy cost savings of 15%, with payback periods of 0.7 years.[4]

Properly maintain HVAC systems.

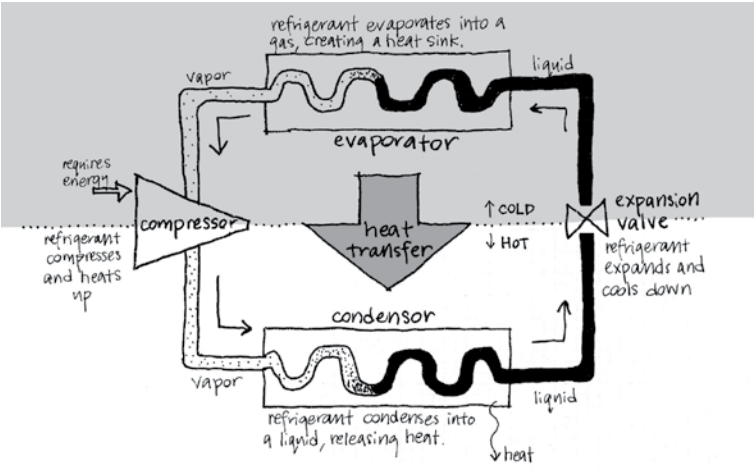
There are three important benefits to having a trained technician perform regularly-scheduled maintenance on your HVAC system:

- **Energy Efficiency**
  A clean and well-maintained piece of equipment will perform efficiently and be less expensive to operate.
- **Extended Equipment Life**
  A well-maintained HVAC system will normally outlast a neglected one by more than two times.
- **System Reliability**
  The cost of sending teachers home for the day is staggering. A well-maintained HVAC system is less likely to experience equipment failure.

EnergySmart Schools:

The US Department of Energy has estimated that schools can save between 5 - 20% on energy costs through implementing best practices for a school's operation and maintenance.

The EnergySmart Schools program provides facility managers a step-by-step manual for operating existing schools more efficiently. **www1.eere.energy.gov/buildings/energysmartschools**



Schematic Diagram Showing Heat Transfer in a Chiller — The Vapor Compression Refrigeration Cycle

HVAC MAINTENANCE
GENERAL CONSIDERATIONS

- Maintenance schedules should be driven by the equipment application and environment, which are different for every installation. For example, an air handler in a welding shop located next to an open grinding shop might need the return air filter changed weekly, whereas a 100% recirculation air handler supplying an interior office might need its return air filters changed only four times per year.

- It is very important to keep heat transfer surfaces as clean as possible. In its simplest form, an HVAC system moves heat into or out of a building through media of refrigerant, water and air. Surface areas where this heat transfer takes place are of critical importance. The most common surface areas are condenser/evaporator coils and condenser/evaporator tubes. As little as 1/64 inch of dust on a coil surface may decrease system efficiency by 10% or more.

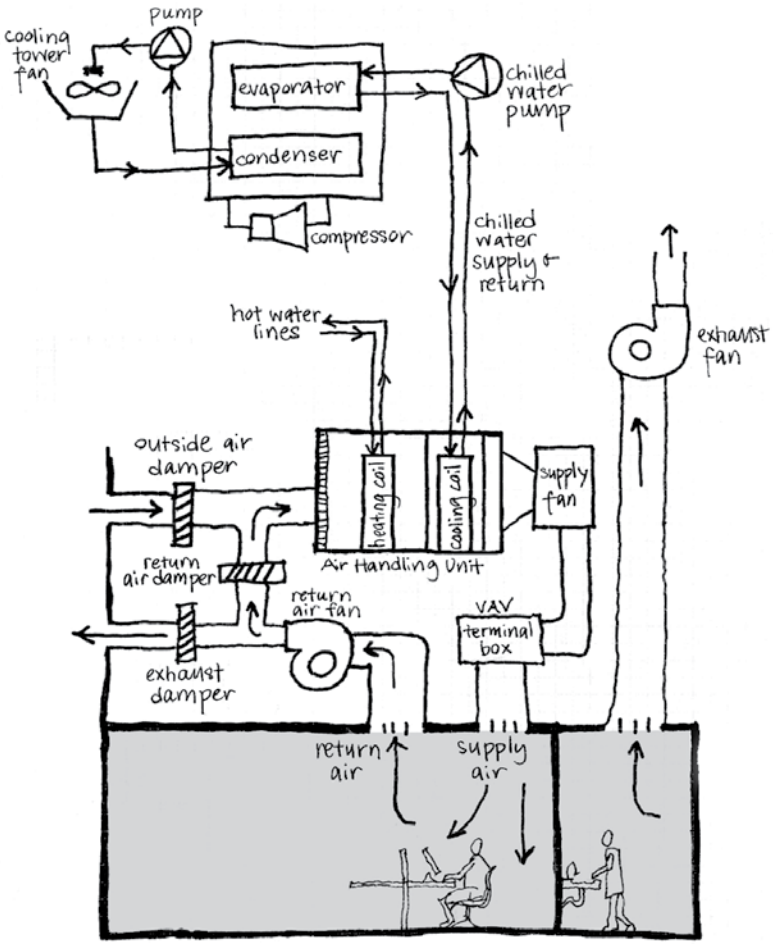
BASIC HVAC MAINTENANCE

- **Filter Change**
  Use 2" pleated filters. They have a longer life and provide better filtration than fiberglass filters. Be sure to seal all areas of "air bypass" around or between air filters. The frequency of changing filters can be set by matching the air pressure drop across the filter with manufacturer's recommendations.

- **Coils**
  Cleaning Schedule: Condenser coils are typically cleaned once or twice per year, but this can vary greatly with the environment. Plantings or construction activity nearby the coils could dictate monthly cleaning. On light commercial units, often the coil must be separated and cleaned between multiple layers. Failure to do this can result in higher than normal system pressures and temperatures, which can shorten equipment life and reduce efficiency. If filter changes are routine, evaporator coils should only be cleaned once per year. In a clean environment, the evaporator coil might need cleaning only once every two years. **Method:** Use water or a mild detergent to clean the condenser and evaporator coils. Do not use a pressure washer or acid-based cleaner. Add pan tabs to prevent slime and mold build-up. Slime can clog system drains and cause drain pan overflows, which lead to water damage and mold growth.

- **Variable Air Volume (VAV) Boxes**
  Inspect annually for proper damper position. A damper out of calibration will cause an area to overheat or overcool. A VAV with electric heat does not need a filter; however, if it has a hot water coil, it should have a return air filter. This filter is typically changed once per year.

- **Ducts and Grilles**
  Ducts are usually a zero-maintenance item. If black, dust-like particles start coming from the grilles, this indicates loose or dirty insulation. In a clean office environment, this might happen every 15 years.



Central HVAC System with Water-Cooled Chiller

Energy Conservation Website:
US DOE Energy Efficiency Information Page:
http://www.eere.energy.gov/topics/buildings.html

MAINTENANCE OF A LARGE INSTITUTIONAL HVAC SYSTEM

- Equipment for a typical water-cooled system includes reciprocating, helical rotary (screw) and centrifugal chillers cooled by an open or closed condenser water loop.
- An on-site employee should do a daily inspection as recommended by the system manufacturer.
- Thorough inspections should be performed by factory-trained technicians four times per year. These usually include three running inspections and one stop inspection. This schedule could vary depending on the age of the system or the customer's comfort level and expertise.

Annual inspection typically includes:

- Check for refrigerant leaks and clean tubes.
- Check electrical system and lubrication system.
- Analysis of oil and refrigerant for contaminants.
- Check for unusual vibrations or alignments.
- Check water and refrigerant pressures.

HVAC maintenance information provided by Scott Schomburg and Guy Gibson of Hunton Trane Services.

Other Energy Conservation Measures

The following energy efficiency strategies are cost effective for certain existing buildings.

Turn off computers at the end of the day.

- You can save 200 to 300 kilowatt-hours per year for each computer turned off versus keeping computers on all the time. This is $20-$30 per computer per year.

Purchase flat screen/LCD monitors.

- A 17" CRT monitor uses about 89 watts, while an LCD monitor uses 35.

IT'S A MYTH

that it takes more energy to start a computer than to keep it running. You will always save energy by turning your computer off when you're not using it. Turning just one computer off at the end of each work day can save up to 600 pounds of greenhouse gas emissions over the course of a year.

CHECK OUT THESE WEBSITES

if you are upgrading your school's windows:

www.efficientwindows.org

www.nfrc.org

Install spectrally-selective film on unprotected windows to block solar gain and reduce cooling loads.

- Use Low Solar Gain, Low-e coatings in humid subtropical climates. Look for:
  - **Visible Light Transmittance (VT)**—This measures how much light is transmitted. Use 70 to 80% if the window is well-shaded, or 40 to 60% if it is not.
  - **Solar Heat Gain Coefficient (SHGC)**—This measures how well a product blocks heat caused by sunlight. SHGC should be as low as possible below 40%.
  - **The ratio of VT to SHGC** should be as high as possible over 1.0.

Install CO_2 monitors. Demand-controlled ventilation using CO_2 monitors can reduce ventilation based on actual occupancy of a space. This saves money and energy.

- CO_2 monitors measure carbon dioxide concentrations in a school, allowing you to track occupancy and the rate of outdoor air ventilation required.
- CO_2 monitoring makes sense in the following situations:[5]
  - In hot, humid climates where approximately half the energy used in the HVAC system is used to remove moisture from the air. Reducing the ventilation load in this situation will produce considerable savings.
  - Schools with variable occupancies. These can include offices, classrooms, and assembly spaces.

ENERGY LESSON

How much energy am I using?

Engage:
The teacher sets up an array of small household appliances, lamps, lightbulbs, and other electrical gadgets. Teacher may also showcase some solar-operated gadgets. When students enter the classroom, they will begin to question why these things they typically see in their home are in the classroom.

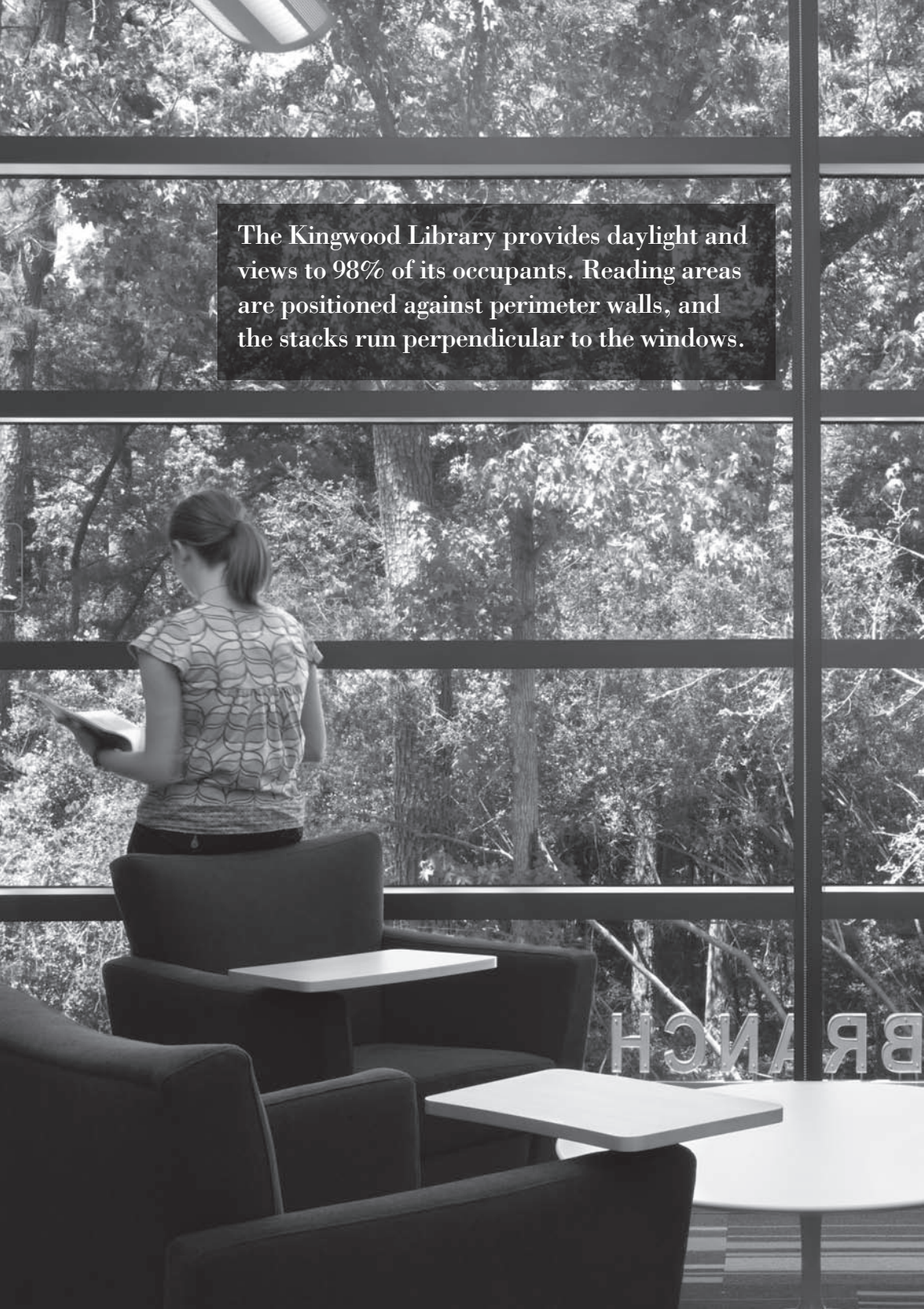
Explain:
Discuss with your students how electricity is created. Discuss the various forms of energy creation that we use in Texas — Coal, Natural Gas, Nuclear, Solar, Wind, and Hydroelectric. Discuss also where source energy is produced. Wind Energy is sourced from Texas, but Coal comes from out of state.

Elaborate:
Find out how much energy per year the school is consuming. You can find out your school's energy use intensity as well as your classroom's energy use intensity. Measure the classroom and find out its energy use intensity (EUI, as discussed in this chapter) by dividing the KWH by its square footage.

Explore:
Have each student determine the square footage of their home and how much electricity they used in the last month. Have them calculate their home's energy use intensity. Make a chart of every student's energy use intensity and discuss possible reasons why some are higher than others.

Evaluate:
Students will create an energy plan for their home or school, which will recommend ways for their family or school to reduce their energy consumption based on the concepts discussed in the chapter. The energy plan should include drawings and charts showing current energy use and projected energy use once the plan is adopted. Students can include the cost savings they estimate from their energy plan.

Some easy ways include raising/lowering the thermostat temperature, turning off lights, replacing incandescent bulbs with cfl's, and unplugging televisions, game consoles, and computers when they are not in use. Some more expensive, but better ways to save energy include replacing single-pane windows with double-pane, adding more insulation, and putting a radiant barrier in the attic.



The Kingwood Library provides daylight and views to 98% of its occupants. Reading areas are positioned against perimeter walls, and the stacks run perpendicular to the windows.

Facing Page: Kingwood Branch Library
LEED Silver Certified

daylight & views at a glance

- ☑ Use space planning to introduce daylight.
- ☑ Bring in direct natural light at the highest window level possible.
- ☑ Use color to reflect light.
- ☑ Avoid direct sunlight at desk level.
- ☑ Use vision glass at classrooms at the perimeter facades of a building.
- ☑ When possible, orient classroom views toward trees and landscaping.

DAYLIGHT AND VIEWS

DAYLIGHT & PROGRESS

A 2002 study by Heschong and Okura showed that students in schools with the largest window surface progressed 15% faster in math and 23% faster in reading compared to those in windowless classrooms.[6]

DAYLIGHT & WELL-BEING

Paladino performed a study in 2005 showing that Green Schools had a 15% reduction in absenteeism, 5% increase in test scores, and 5% reduction in teacher turnover.[7]

Daylight

People almost universally prefer daylit spaces to artificially-lit spaces. Studies have shown that test scores improve in daylit spaces.

Wherever possible, use good space planning to introduce daylight to the interior of your school.

- Keep storage and non-occupied spaces away from perimeter walls to allow natural light into the classrooms and frequently occupied spaces of your school.

Allow direct natural light to enter at the highest window level possible.

This will throw light to the rear of an interior space and help prevent glare.

- Consider top-down, bottom-up blinds or light shelves to allow direct sun in only at the top of windows where it is most useful.

Carefully consider color and material choices.

- Don't use large areas of dark color. Walls facing windows should be light-colored, with a Light Reflectance Value of 50% or above. Paint samples should list LRV.
- Ceilings should be white or off-white.
- Use light-transmitting materials like glass wherever possible.

Avoid direct sunlight at occupant level.

- It causes thermal discomfort and glare.

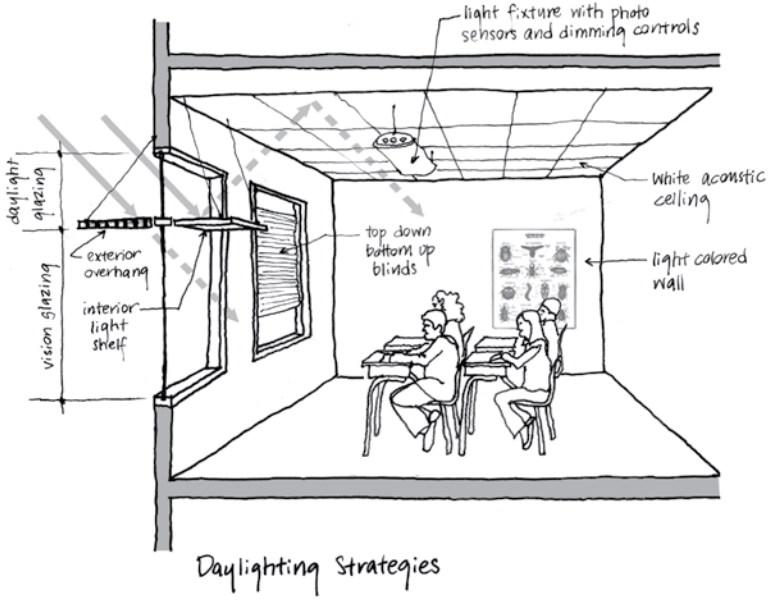


Diagram illustrating daylighting strategies for a typical classroom.

Properly designed and implemented daylighting strategies can reduce electricity use for lighting by 50 - 80%.[8]

DAYLIGHT AND VIEWS

STUDIES

BIOPHILIA

A 1993 study by Robert Ulrich of Texas A&M University showed that views to nature positively influence mood-enhancing cognitive activity.[9]

INVESTING IN PEOPLE

A 2006 study by Judith Heerwagen, Ph.D showed that "workers with a view to nature have less stress and improved emotional functioning, attention and cognition. This can be translated to students who 'work' in our schools for similar time periods."[10]

Where possible, use west-facing spaces for service areas. Service areas include storage rooms, janitor closets and windowless restrooms.

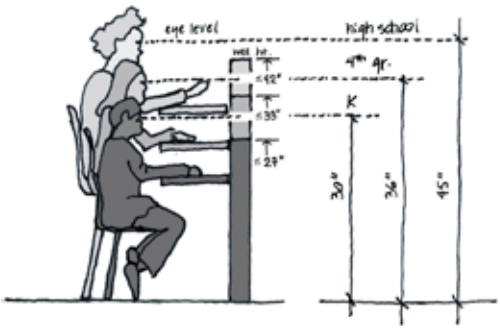
- Western exposures receive direct sunlight in the afternoon when the sun is at its hottest. This makes them thermally uncomfortable.

Views

Providing views has been shown to have a significant impact on the satisfaction, productivity, and health of building occupants.

Ensure views from every classroom and office.

- Construct walls or partitions with a maximum height of 3'-6".



Use vision glass at the front of perimeter spaces.

Provide views of trees or landscaping.

DAYLIGHT AND VIEWS LESSON

Engage:
The teacher will display and discuss windows and the associated buildings to which they belong. Can one determine building type by its windows? How?

Explore:
Students will search the internet or family photos to collect images of windows they have seen and that they like.

Teacher will select images of a variety of windows and buildings to supplement the students' selections and present a diverse window selection.

Explain:
Students will discuss their selections of windows — what function do these windows serve, based on their appearance and location?

- How big is the window and why?
- Is the glass colored or tinted?
- Can they see out of the window?
- How might the window in a church differ from the window in a house?

Elaborate:
Teacher and students will discuss what would be a good window for different classroom types - Art, Science, Math, English, etc.

Evaluate:
Students will draw windows in their sketch books or make a collage creating a building with the windows they have selected. Students can write a composition about how a window can influence the feeling in a space. Students will share their descriptions and drawings with the rest of the class.

04

At the Parish School, the selection of only native species, efficient irrigation systems, and a controller drastically reduced the building's demand for potable water.

Facing Page: Parish School
17-acre campus

site & landscaping at a glance

- ☑ Plant native or well-adapted species.
- ☑ Minimize turfgrass.
- ☑ Avoid synthetic chemical fertilizers.
- ☑ Plant perennials.
- ☑ Plant shade trees.
- ☑ Maintain groundskeeping equipment properly.
- ☑ Care for turfgrass appropriately.
- ☑ Minimize stormwater runoff.
- ☑ Reduce the heat island effect.
- ☑ Use drip irrigation.
- ☑ Maintain irrigation equipment.
- ☑ Install irrigation controller.
- ☑ Check exterior light levels on your property.
- ☑ Use timers on outdoor lights.
- ☑ Choose full cut-off light fixtures.

SITE AND LANDSCAPING

Vegetation

Choosing the right vegetation for your school will save money on maintenance and irrigation, and will help to create a healthy ecosystem and learning environment.

Plant native or well-adapted species.

- They will use less water and be easier to maintain.

Minimize turfgrass.

- Reduce or replace areas of turfgrass with native grasses, groundcover, or shrubs.
- Beware of invasive species.

WHAT'S WRONG WITH TURFGRASS?

Lawns occupy roughly 50 million acres in North America—that's an area 40% of the size of Texas.

Americans use 3-6 million tons of fertilizer on lawns every year. Nitrogen fertilizers are extremely energy-intensive to make, using 18,000 BTUs of energy per pound.

Watering lawns consumes 30% of municipal freshwater in the eastern US, and 60% in the western US. In urban areas of Texas, 40-60% of the water supply is used for landscape watering.[11]

The 90 million lawnmowers, weed trimmers, and other small engine lawn and garden tools in the US produce 5% of the nation's air pollution.[12] A conventional lawnmower pollutes as much in an hour as a car does driving 100 miles.[13]

US lawns receive heavier pesticide applications than agricultural land: between 3.2 and 9.8 lbs/acre vs. an average of 2.7 lbs./acre for agriculture.[14] Americans spray 70 million pounds of pesticide on lawns each year.[15]

Stormwater runoff from turf is one of North America's biggest sources of water pollution.[16]

FOR A LISTING OF NATIVE PLANTS
and nurseries in your area, see www.plantnative.com

Use mulch, organic fertilizers, and compost instead of synthetic chemical fertilizers.

Synthetic chemical pesticides are detrimental to the health of organisms in the soil. As soil organisms die over time, plants are deprived of required nutrients.

- Use only high-quality compost; it is fully decomposed and has no odor. Spread 1/6" to 1/2" thick once a year in spring or early summer. Apply manure-based composts sparingly.[17]

Perennials with staggered bloom cycles require less water and maintenance than annuals.

- Check out these books for lists of native Southeastern and Gulf State perennials and advice about landscaping with them:
  - Howard Garrett. *Howard Garrett's Plants for Texas*
  - Samuel Jones and Leonard Foote. *Native Shrubs and Woody Vines of the Southeast*
  - Sally and Andy Wasowski. *Gardening with Native Plants of the South*

When fertilizers wash into surface water, they stimulate the growth of algae. When the algae decays, it robs ecosystems of oxygen through a process called eutrophication, killing aquatic life.[18]

Use trees to mitigate climate conditions.

- Trees may be planted to protect the eastern and western façades of a building from sun.

RECOMMENDED TURFGRASSES FOR SOUTHEASTERN & GULF COAST STATES

	Native	Mowing Height	Sun Requirements
St. Augustine	✓	2 1/2 - 3 1/2"	Partial shade
Buffalograss	✓	2 1/2 - 3"	Partial sun
Seashore Papsalum	✓	<1"	Full sun
Bermuda		1 - 1 1/2"	Full sun
Zoysia		1 - 1 1/2"	Partial shade
Centipede		1 - 2"	Partial sun

(source: Texas A&M Turfgrass Program)

- Suitable native deciduous shade trees to plant in Gulf Coast and Southeast Atlantic states:

  - Drummond Red Maple
  - River Birch
  - Pecan
  - Black Gum
  - White Oak
  - Bur Oak
  - Willow Oak
  - Shumard Red Oak
  - Live Oak
  - Hackberry
  - Magnolia
  - Texas Ash
  - Cedar Elm

For more information
about the heat island effect, see the EPA Heat Island Effect website: www.epa.gov/heatisland

Grounds

Check that your lawn maintenance professionals clean and sharpen groundskeeping equipment once a week.

For healthy turfgrass, take the following steps:

- No more than 1/3" of the grass blade should be removed in one mowing.
- Use a mulching lawnmower.
- Allow grass to grow a little longer; longer grass is healthier and retains moisture better.

Dull blades can tear grass and make it more vulnerable to pests and disease.

Minimize stormwater run-off.

- Eliminate unneeded paved areas.
- Use pervious paving.
  - It acts as a stormwater filtration system, removing suspended solids and phosphorus from stormwater.
  - Pervious pavement is ideal for low-traffic areas like parking lots and sidewalks.

Reduce the heat island effect.
Urban areas are paved with surfaces that tend to absorb solar radiation, raising the average temperature of the city. This is known as the heat island effect.

URBANIZED AREAS ARE HOTTER

than surrounding rural areas by 2°F to 10°F. These higher temperatures contribute to air pollution and higher energy costs. Roads, buildings, and other hard surfaces absorb and retain heat, leading to surface temperatures 50°F to 70°F hotter than surrounding areas.[19]

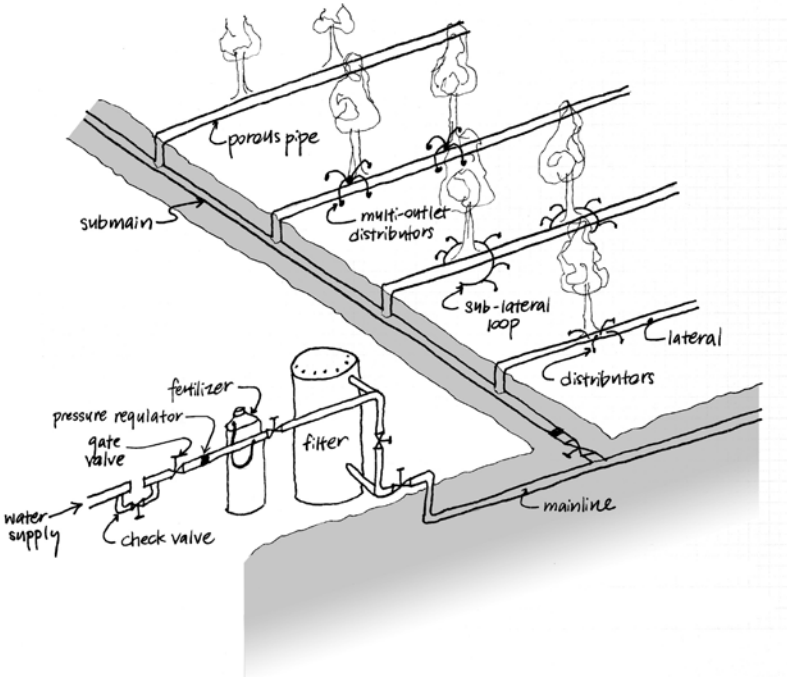
DRIP IRRIGATION

may use less than half of the water consumed by conventional systems, and often produces faster, healthier plant growth.[20]

- Use pervious paving or pavement with 30% or greater reflectance to counter the heat island effect. Appropriate paving includes the following:
  - Light-colored cement concrete
  - Interlocking concrete pavers
  - Open-grid pavers filled with gravel or native grasses

Irrigation

The following strategies will conserve water.



A Typical Drip Irrigation System

Use drip irrigation.

- Micro irrigation, such as drip and bubbler systems, release water just where it is needed.
- Drip systems are buried a foot or more into the ground and supply water directly to a plant's roots.
- Slow-release and targeted-application minimize water wasted through evaporation and runoff.

ANNUAL IRRIGATION CHECKLIST

- Check time and schedule operation.
- Check sprinkler system.
  - Observe the spray patterns and position of the sprinklers for clogged or misaligned heads.
  - Clean and replace filter screens if necessary.
  - Leaks and misting from sprinkler heads may indicate high water pressure problems. These may be corrected by plumbing a pressure regulator into the sprinkler system.
- Check drip system.
  - Replace clogged emitters. Add a water filter if the system does not have one.
  - Check the placement of emitters. Emitters should be at the edge of the root-ball on new plantings and at the drip line (edge of foliage) of established plants.
  - Check for emitters where tubing has popped off because of high pressure, and install a pressure regulator if needed.
  - Missing and broken emitters must be replaced to keep the system running efficiently.
- Check irrigation controller.
- Check automatic valves.
- Flush the system.
  - Remove the last sprinkler head in each line and let the water run for a few minutes to flush out any dirt and debris. Replace the sprinkler heads and turn the system on, running one valve at a time.

Use irrigation controllers.

- Adjust irrigation timing at least monthly to account for seasonal weather changes.
- Deep, infrequent irrigation is best for the overall health of turfgrass. It reduces disease, helps insure good air movement down to the root system, and conserves water. Apply enough water to wet the soil to a depth of six (6) inches.
- The best time to irrigate is early morning.
- Make sure your system includes a rain sensor, an inexpensive device that turns off irrigation when it rains.
- The most efficient sensor is an in-ground moisture sensor. These are the most expensive, but will save the most water by preventing irrigation when the soil moisture level is adequate.

Maintain irrigation equipment.

- Examine the irrigation system for damage or malfunction monthly.
- Have landscaping company perform an annual irrigation system check. (See checklist.)

Site Lighting

The following strategies will help eliminate light pollution and trespass.

Provide the lowest light levels required to address safety, wayfinding and identification.

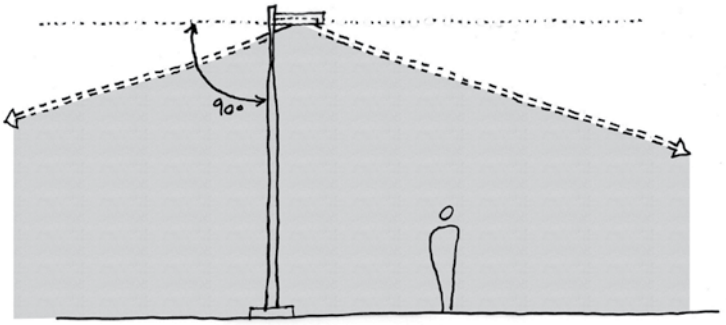
- Use directional light fixtures to light only the desired surface.
- An average horizontal illuminance of 3 footcandles is an appropriate amount of light to secure a property.

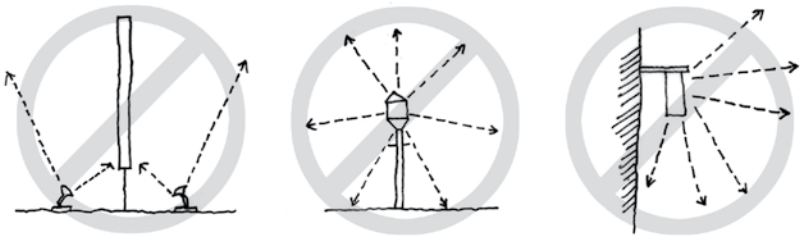
Use timers to turn off outdoor lights at hours when they are not needed.

Use solar panels to run your light fixtures so they can be self-contained units with integrated batteries and timers.

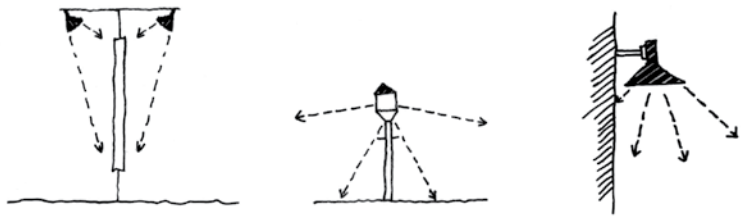
Choose light fixtures with the following qualities:

- Full cut-off fixtures that ensure light goes only where needed.
- Opaque reflectors that direct light downwards.





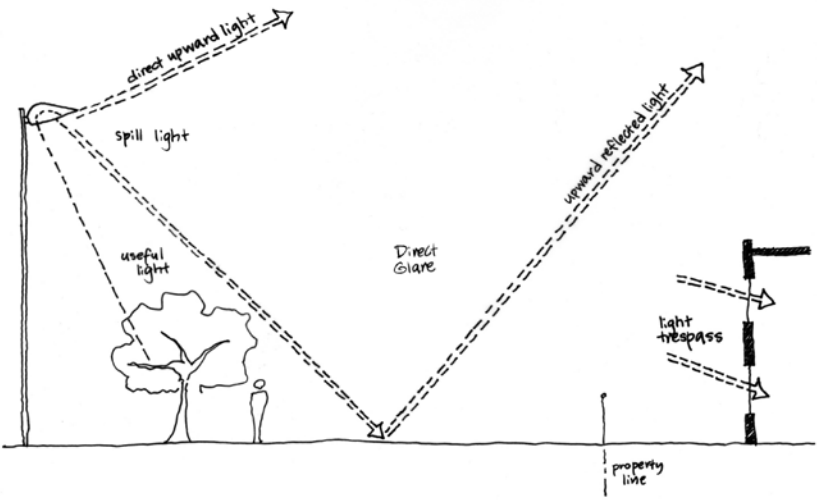
POLLUTING light fixtures



NON-POLLUTING light fixtures

What is Light Pollution?

Light pollution is caused by any electric lighting that has the potential to cause adverse effects to humans, the ecosystem, or the nighttime environment. These adverse effects include glare, compromised visibility, light trespass, visual clutter and confusion, energy waste, and sky glow.



Light pollution from a typical street lamp

Site Lighting Website:
International Dark Sky Association: www.darksky.org

Houston is a major flight zone for migratory birds in the U.S.

WHY LIGHT POLLUTION MATTERS

Light pollution competes with the light from the stars. Even in a rural village, artificial light is likely to be twice the brightness of the night sky; in a typical suburb, light pollution may exceed the night sky brightness five-fold, and in a moderate-sized city, the difference is 20- to 25-fold.[21]

Light pollution presents a potent threat to professional astronomy. Many advances in astronomy require observations of very faint objects that must be studied with large telescopes located well away from population centers. Most of these observations of cosmological interest deal with extremely remote sources: galaxies or quasars at such great distances that their light has traveled for billions of years. This light can then be lost in the glare of our civilization in the last 1/1000 of a second of its journey.[22]

Birds are attracted to light. Lights left on at night can cause birds to become disoriented and fly into windows, or trapped by a beam of light and if unable to land, birds can become exhausted and literally drop to the ground. Studies suggest that between 100 million and one billion birds die each year in the US as a result of striking windows.[23]

The International Dark Sky Association estimates one billion dollars in energy costs and 23 million barrels of oil are wasted each year in the United States due to light trespass, pollution, and glare.[24]

Image of the US at night showing areas of light pollution

BUILD A GARDEN

Why build a garden at your school?

In addition to teaching your students about biology, mathematics, and nutrition, student gardening programs are a chance to explore the natural world and learn first-hand the benefits of growing, harvesting, and eating healthy foods.

What it takes to build a garden

The old African saying "it takes a village to a raise a child" also applies when creating and tending to a garden. Additionally, the garden is a great opportunity for your school to build a community. Studies show that school children who have contact with individuals from the community fare better in their academic pursuits.

In order to design, build, maintain, harvest, and protect your garden, your school should solicit volunteers from the community to help in all phases of the garden. Design and construction are the most technical areas, but any parent can come and help pull weeds or irrigate as part of an after-school program.

The science behind the garden

A 2005 study by Heather Graham, Ph.D. assessed elementary school teachers' perceived attitudes and barriers associated with school gardens. The study also assessed the purpose and use of gardens in schools relative to attitudes about nutrition. The teachers perceived the garden to be somewhat to very effective at enhancing academic performance, physical activity, language arts, and healthful eating habits. Nutrition was taught through the use of the garden by most of the responding teachers.[25]

A 2007 study by Jessica D. McAleese, MPH investigated the effects of garden-based nutrition education on students' fruit and vegetable consumption compared to a control group. The results of the study indicated "the efficacy of using garden-based nutrition programs to increase adolescents' consumption of fruits and vegetables." [26]

Recipe for Success

Bringing good nutrition to your school

Founded in 2005, Recipe for Success Foundation (RFS) is waging war against the childhood obesity epidemic. Their weapons of choice are fruits, vegetables, school gardens, and cooking classes. RFS has created a Seed-To-Plate Nutrition Education™ program that focuses on teaching children what good food is, how to grow it, and how to cook it.

The Seed-to-Plate program has already created six school gardens in the Houston area that are integrated with after-school cooking programs. Some of these campuses include HISD's Rodriguez Elementary and MacGregor Elementary and the KIPP SHINE Preparatory School.

Urban Harvest

The Urban Garden Creators

Urban Harvest's mission statement is "to promote healthy communities, sound nutrition, and respect for the environment by educating children and adults through facilitating harvest and habitat gardens." They have created a gardening education program to offer classroom and hands-on experience to students and teachers. In addition, they are a valuable resource to help plan, design, coordinate, and plant a garden at your school.

Urban Harvest Gardens are at many schools around Houston. One of the oldest is 27 years old at McDade Elementary School. The produce goes to the Target Hunger program, which supplies food to Houston's Fifth Ward families.

Want to learn more about these groups?

recipe4success.org
urbanharvest.org

SITE AND LANDSCAPE LESSON

Create a Student Garden for your School

Engage:
Show pictures of vegetables to your students. Ask them where they come from and why they are good to eat. Ask them how many they eat every week and to compare that number to how many frozen pizzas or hot dogs they eat weekly. Ask them if they ever wondered where their vegetables came from and how they were grown.

Explain:
Show pictures of gardens and farms of various types from your area and show their locations on a map.

Explore:
Have the students break into teams and design a garden for your school. Get a site plan of the school to distribute to the students. They will have to determine the size, location, and design of the new garden.

Here are some things for your students to consider:

- **Water** — close, easy access to a water source is essential.
- **Sunlight** — a minimum of six hours of direct sunlight per day is necessary to grow most vegetables and flowers.
- **Engaging Gardeners** — a plan for getting and keeping teachers and students involved in the garden.
- **Size and type of garden** — in-ground gardens vs. container gardens
- **Size of site** — do you have plenty of room for students to work? Walkways between plantings? Areas to sit for group discussions, compost and tool storage?
- **Security** — be sure the site is located in an area that will discourage vandalism and minimize damage from playground havoc, dogs and foot traffic.
- **Permanence** — is the site available for the foreseeable future? Or, is your garden design easy to relocate if a permanent site is not available?

Evaluate:
Have the class create a business plan and proposal for the new garden. Estimate the amount of food that the various gardens could produce based on yield estimates, when the garden will need to be irrigated, how much fertilizer and compost you will need, and (if you are ambitious) how much the garden will cost.

Urban Harvest and other websites have yield calculators, water estimators, "good practice" info, and more!

Here are some tools to help.

Yield Calculator –
http://usagardener.com/breaking_ground/plan_a_vegetable_garden.php#yieldchart

When to Plant –
http://www.easy-vegetable-gardening.com/vegetable-gardening-planting-times.html

Compost Ratio –
A garden blend (45% compost, 45% topsoil, 10% sand), and a 50/50 blend of compost and topsoil.

A ***green school*** goes beyond simply conserving resources; it can also act as a teaching tool to educate our youth to be good stewards.

Facing Page: Kirksey Corporate Headquarters Addition
LEED Gold Certified

water at a glance

- ☑ Identify and repair leaks.
- ☑ Retrofit older plumbing fixtures to reduce water use.
- ☑ Install a separate water meter to measure interior water usage.
- ☑ Install low-flow and sensor-activated fixtures.

Interior Water Use

There are many ways to increase water efficiency in your school. Take the following steps to save money on water bills and help recharge natural watersheds.

Identify and repair leaks.

- Use an interior water meter to identify leaks.

Retrofit older plumbing fixtures to reduce water use.

- Install low-flow aerators on lavatory and sink faucets. The Bricor B15-16 DTK aerator goes down to .375 gpm. Be sure to check that water pressure is compatible with the aerator you purchase.
- Flush-valve toilets may be retrofitted with dual-flush valves. See below for more information.
- Install ADA low-flow shower head attachment
- Replace showerheads with low-flow showerheads using 2 gallons per minute or less.
  - For more information, go to www.bricor.com or visit the low-flow product lines of other major manufacturers.

When replacing plumbing fixtures, install low-flow and sensor-activated fixtures.

- **Low-Flow Faucets**
  - The Energy Policy Act of 1992 established **2.5 gallons per minute** as the maximum flow rate for faucets.
  - Aerators are available to reduce flow to as low as 1.375 gpm.
  - Sensor-controlled faucets save water by automatically turning on and off only when the sensor is triggered.
  - Toto **EcoPower** sensor faucets deliver 0.5 gpm with a 10-second cycle time. The sensor battery is charged by the water itself.
  - Sloan **Optima Solis** Solar-Powered sensor faucets deliver 0.5 gpm. The solar cell powering the sensor battery is charged by either sunlight or fluorescent light. Costs are 15-20% more than Sloan non-solar sensor faucets.

- **Low-Flow Toilets**
  - The Energy Policy Act of 1992 established 1.6 gallons per flush for toilets.
  - Low-flow toilets use 1.28 gpf or less. Toilet water usage can be reduced by 30% by making this change.
  - Low-flow toilets have improved their flushing power to equal the efficacy of 1.6 gpf toilets. They are available in both floor-mounted and wall-mounted models.
  - Both tank-type toilets and flushometer valves are available in low-flow versions.

Water Use Websites:
EPA water issues site:
http://water.epa.gov
American Waterworks Association:
www.awwa.org

- **Flushometer Valves**
  - These valves allow a typical flush as well as one that uses 30% less water, depending on whether it is pulled up or down.
  - Sloan ECOs automatic dual-flush flushometer or Sloan UpperCut manual dual-flush flushometer.
  - Zurn dual-flush flushometer.

- **Low-Flow Tank Toilets**
  - Turbo **Capizzi**. Pressure-assisted toilet using 1 gallon per flush.

LEAKS

account for almost 14% of water use in homes.[27]

AMERICANS

extract 3,700 billion gallons of water per year more than they return to the natural water system to recharge aquifers and other water sources.[28]

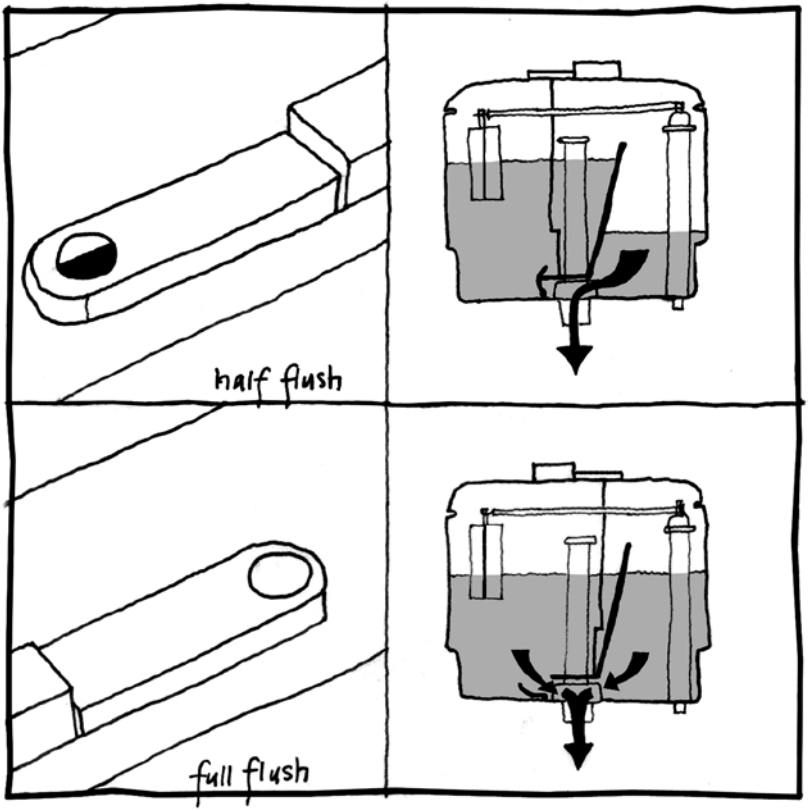
FOR TESTING

research on the flushing performance of various toilets, check out the **Maximum Performance (MaP) Testing of Popular Toilet Models** study, conducted by Veritec Consulting and Koeller and Company for American and Canadian municipal water companies.

www.cwwa.ca

- American Standard **Fontaine**. Pressure-assisted toilet using 1 gallon per flush.

- **Dual-Flush Tank Toilets**
  - A dual-flush toilet has one button that triggers a **1.6 gallon** flush and another button that triggers a **.8 - 1.1** gallon flush.



Flushing mechanism for Caroma Dual-Flush toilet

- Caroma **Caravelle** and **Reflections** toilets provide a choice of .8 and 1.1 gallon flushes. Prices are comparable to non dual-flush toilets.
- Toto **Aquia** has a high flush of 1.6 gpf and a low flush of .9 gpf.

- **Low-flow Urinals**
  - If waterless urinals can't be used, low-flow urinals are a good option.
    - Many manufacturers make urinal flush valves that will flush with 1/2 gallon or less. These include the **AEF-801 Dualflush** by AMT Corporation and the **8186-0.5** valve by Sloan.
    - Zurn One **Small Pint** Ultra Low Consumption Urinal System. This urinal and valve with automatic sensor delivers 1/8 gpf.

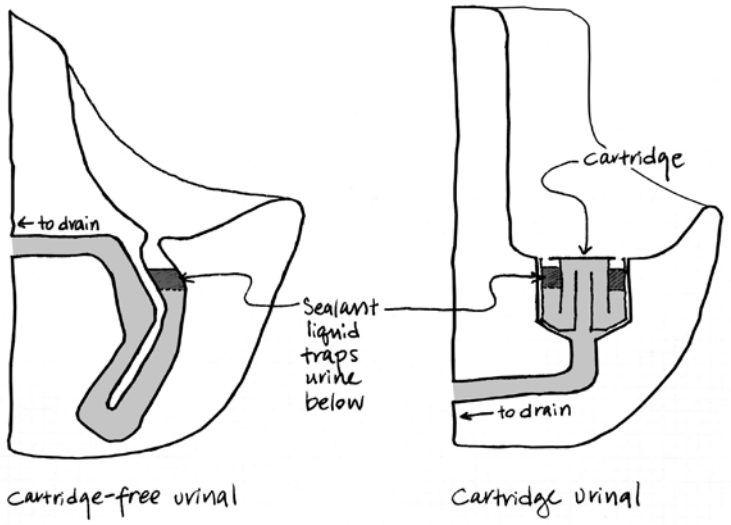
Plumbing Fixture Manufacturer Websites:
www.sloanvalve.com
www.bricor.com
www.oxygenics.com
www.totousa.com
www.americanstandard-us.com

Low-Flow Toilet Manufacturer Websites:
www.capizzi.com
www.mansfieldplumbing.com

Dual-Flush Toilet Manufacturer Websites:
www.zurn.com
www.caromausa.com
www.gerberonline.com

Waterless Urinal Manufacturer Websites:
www.waterless.com
www.falconwaterfree.com
www.sloanvalve.com
www.duravit.com

- **Waterless Urinals**
  - Falcon **Waterfree** Urinals. Cartridge replacement costs $35 per unit plus $5 labor, every 7,000 uses.
  - Sloan **Waterfree** Urinals.
  - Non-cartridge-based models have an internal ceramic siphon that must be flushed out once a month. They can be up to 2 times as expensive as cartridge models, but will be cheaper to maintain.
    - Duravit **Dry**.
    - Kohler **Steward**.
  - Waterless urinals do not use water and have no flush valves. This can save considerable water and maintenance.
  - Models are typically available in fiberglass and vitreous china.
  - Check local code requirements, as some jurisdictions do not allow waterless urinals.
  - Cartridge-based models start at $300 and must have a cartridge replaced every 5,000 - 7,000 uses.



Types of waterless urinals

WATER EFFICIENCY LESSON

How Much Water Do You Use?

Engage:
A short film on the desert and how that landscape conserves and collects water to sustain itself.

Explain:
Discuss with your students about where the water they use comes from, what the municipal water treatment plants do, and about the national water deficit. Ask them why it is important to conserve water and ask them how they would get water if not already in their house.

Explore:
Determine the flush and flow rates of the water fixtures your students use.
This can be done by either reading the flow and flush rates on the fixtures, asking your maintenance staff, or with a bucket.

For 1 week, have each student monitor how many times they use the restroom, wash their hands, and how long they wash their hands (at school only). If they have access to a timer, they will be more accurate. Give them a chart to keep track.

At the end of the week, have them multiply the number of times that they used each fixture by the flush or flow rate and then by the minutes they used flow fixtures. Then multiply that by the number of weeks in the school year. Each student will then have a **water use estimate**. Add up the estimate for each student and you will have your **Class Water Use Estimate**.

Elaborate:
Using the flush and flow rates in this chapter, determine how much water your class could save each year by running the calculation again. Have them multiply the number of times that they used each fixture by the new flush or flow rate and then by the minutes that they used flow fixtures. You will have a **high-efficiency fixture water use estimate**. Subtract the amount of water from the high-efficiency calculation from the original class water use estimate to determine how much water your class could save each year by using current technology.

Evaluate:
Convert the volume of water in gallons to cubic feet by multiplying the gallons by .134 cubic feet to determine the volume. Measure the volume of your classroom. Determine how many classrooms you could fill with the water that you use each year, then measure how many classrooms you could fill with the water you save.

Create a chart or diagram that illustrates the information you collected.

Keeping pests out of buildings begins by restricting their access. Separating landscaping from the building envelope is one way to do this, as shown here at the John Cooper School.

Facing Page: John Cooper School
415-Seat Dining Facility

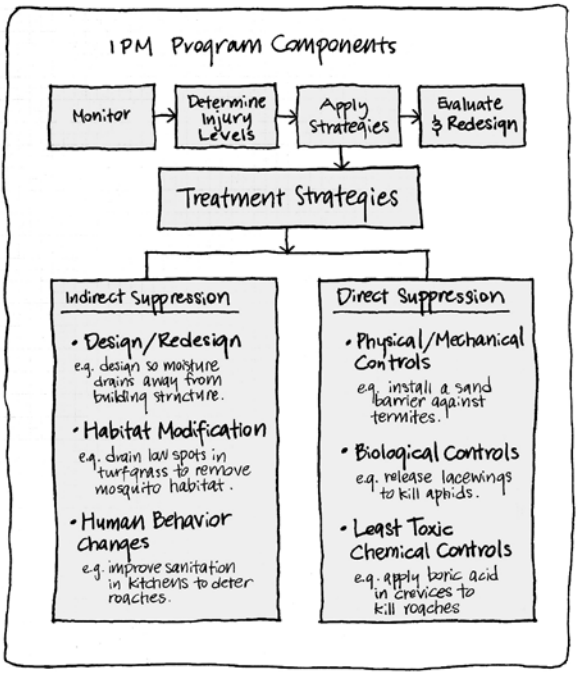
pest management
at a glance

- ☑ Use Integrated Pest Management.
- ☑ Inspect for pests frequently.
- ☑ Make your building less attractive to structural insects.
- ☑ Keep the interior of the building clean and dry.
- ☑ Use humane baits and traps.
- ☑ Apply pesticides with care.

Monitoring and Prevention

Pest populations can be controlled with methods that are not damaging to human health.

Use Integrated Pest Management (IPM), an alternative approach to controlling pests that emphasizes regular monitoring and prevention.



(source: *Common Sense Pest Control*. Olkowski, Daar, and Olkowski)

Pest populations should be monitored with frequent inspections and traps.

- Collect data on pest populations with traps. This will tell you if you have pests, where they are concentrated, and where pest management activities have succeeded.

Control structural pests such as termites, carpenter and fire ants, and woodboring beetles.

- Make sure there is no wood in contact with soil.
- Make sure soil surface slopes away from buildings to carry water away from the foundation.
- Check for damaged or poorly fitting windows, doors and sills.

Keep outdoor pests out.

- Caulk and seal building points of entry.
- Trim landscaping to keep it 18" away from the building façade.
- Dispose of food waste in rodent-proof dumpsters.

Prevent the spread of indoor pests.

- Keep work areas and garbage areas clean and dry.
- Caulk and seal cracks and crevices where roaches hide.
- Place food waste in sealed plastic bags.
- Repair leaky plumbing fixtures.
- Rinse food containers before placing them in recycling bins.

Educate building users.

- Provide information to employees about how to properly dispose of waste and store food.

REDUCING PESTICIDES

In Minnesota Schools, a two-year pilot project showed that it is feasible to implement Integrated Pest Management without incurring additional costs.[29]

OVERUSE OF PESTICIDES

may cause problems, such as

- killing beneficial organisms that would otherwise help control pests
- promoting the development of pesticide resistance
- resurgence of pest populations
- contamination of the environment

EPA Guide to Integrated Pest Management in Schools:
www.epa.gov/pesticides/ipm

Beyond Pesticides, a National Coalition Against the Misuse of Pesticides:
www.beyondpesticides.org

Treatment

If you have a pest problem, there are safer ways to address it.

SELECTED LEAST TOXIC PESTICIDES

Pesticide	Type	Pest	Method of Action
Silica Gel	Insecticidal Dust	Cockroaches, ants drywood termites	Dehydration
Diatomaceous Earth	Insecticidal Dust	Cockroaches, ants drywood termites	Dehydration
Boron	Insecticidal Dust	Cockroaches, ants	Stomach Poison
Insecticidal Soap	Liquid (based on petroleum or natural oils)	Soft bodied plant pests; aphids, adelgids, mealybugs	Dissolves outer body of insect
Horticultural Oils	Liquid	Aphids, beetles, caterpillars	Smothering
Pyrethrum	Botanical Powder	Ants, aphids, beetles cockroaches, flies, mosquitoes	Paralysis
Limonene & Linalool	Citrus Peel Extract	Fleas, aphids, mites, fire ants	Paralysis

(source: Common Sense Pest Control. Olkowski, Daar, and Olkowski)

Use the least toxic pesticides required.

- Less toxic pesticides are listed in the chart opposite. Remember that all pesticides can be dangerous and should be handled with gloves and eye protection.

Avoid these pesticides:

- Pesticides with ingredients labeled by the US EPA as probable, likely, or known carcinogens or endocrine disruptors.
- Mutagens, reproductive toxins, developmental neurotoxins, or immune system toxins.
- Pesticides classified by the US EPA as having a toxicity of I or II.
- Pesticides in the organophosphate or carbamate chemical family.
- Pesticides containing inert ingredients categorized as List 1: Inerts of Toxicological Concern.

Signal Word	Toxicity	Oral Lethal Dose
Danger	Highly toxic	Few drops to 1 teaspoon
Warning	Moderately toxic	1 teaspoon to 1 tablespoon
Caution	Low toxicity	1 ounce to more than 1 pint

(EPA Pesticide "Signal Words")

Apply pesticides with care.

- Inform employees in advance of pesticide applications.
- Locate areas of pest concentration, focusing treatment there and in adjacent areas.
- Avoid applying pesticides using broadcast spray, dust, tenting or fogging.
- Do not spray pesticides when using baits. Spray pesticides will repel insects, while the baits are intended to attract them.
- Take note of the label. All traditional pesticides are labeled with one of three signal words to indicate degree of toxicity. (See chart above).

BAITS & TRAPS

are preferable to sprays. Fumigants are among the most toxic pesticides.

CHILDREN

who have been exposed to household insecticides and professional extermination methods within the home are three to seven times more likely to develop non-Hodgkin's lymphoma (NHL) compared with children who have not been exposed to pesticides.[30]

Resources to use for research on pesticides:

Material Safety Data Sheets (MSDS) contain information about toxicity, including the EPA carcinogenicity rating.

The Extension Toxicology Network has pesticide information profiles, including EPA classification and detailed toxicological information. http://extoxnet.orst.edu/

EPA List of Inerts of Toxicological Concern:
www.epa.gov/opprd001/inerts/fr54.htm

PEST MANAGEMENT LESSON

How do we safely prevent pests?

Engage:

The teacher will strategically place plastic bugs around the room before students arrive for class. When they enter the room, students will question the purpose of the bugs.

Explore:

Students will create a house using a shoe box, cutting slits in the sides and along the bottom of their house for ventilation. Using materials provided by the teacher, students will create possessions to go in their house, consisting of anything from food to their special toys. Students will place their house on a tray made of aluminum foil and set aside until tomorrow.

> ***Overnight, teacher will add sand and/or rice to aluminum trays. This sand/rice will seep through the slits in their houses, looking as if "pests" have entered their homes.***

Explain:

The next day, students will see that their homes have been infiltrated by "pests." Class will discuss how this happened. In groups, classmates will discuss the following questions:

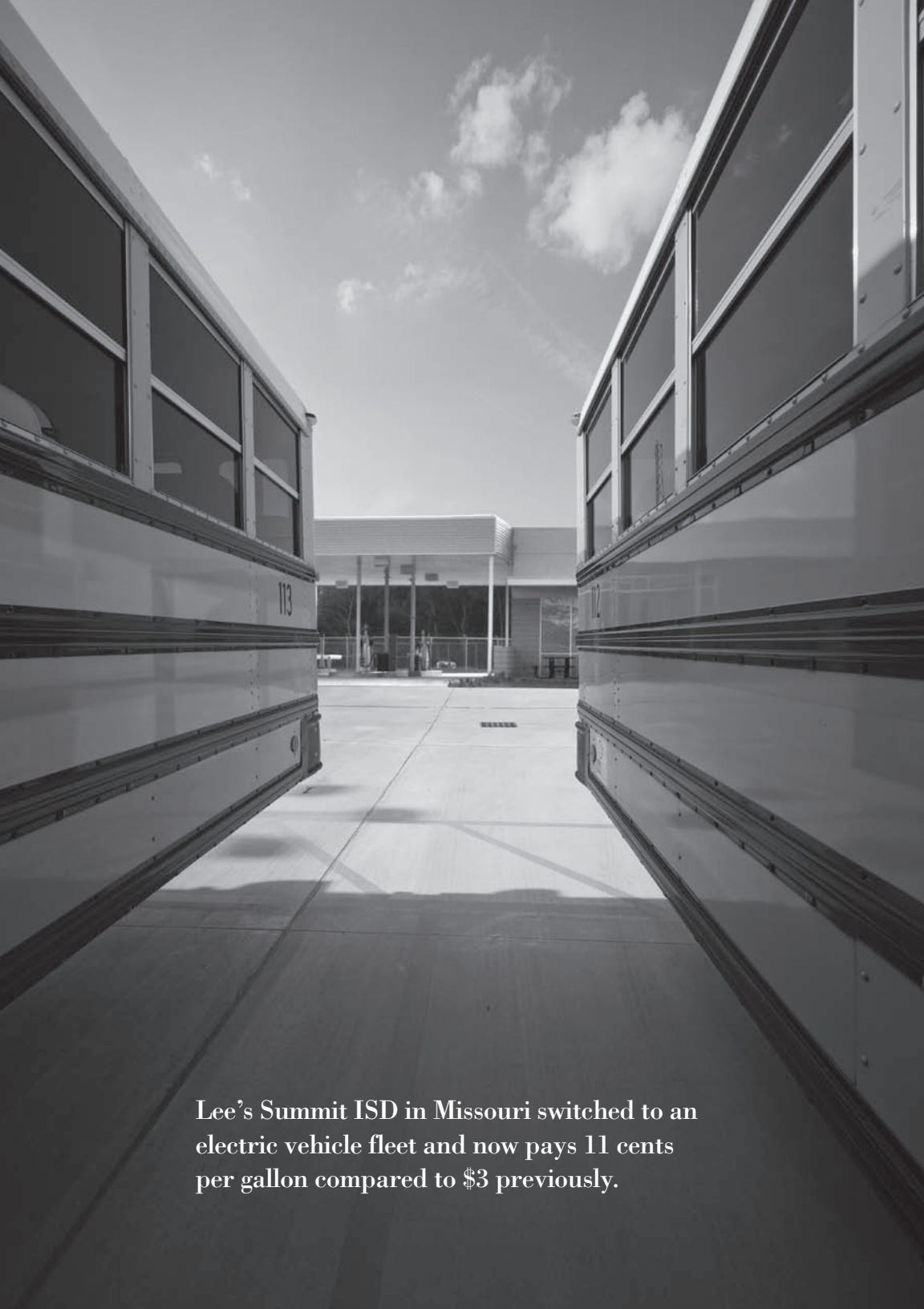
- **Where did the sand come from?**
- **Is it harmful to my possessions?**
- **How can I fix it?**
- **Why did this happen?**
- **Can I live here?**

Elaborate:

The teacher will set out a variety of materials again. Using these materials, students will be prompted to "fix" their houses so that this does not happen again. Teacher will ask students what they will need to do to the outside and inside of their house to keep the sand/rice from seeping in again. Some ideas would be to seal the building, put food into closed containers, etc.

Evaluate:

Students will answer the following question in their science interactive notebook: What advice would you give an architect or builder regarding how they should construct their buildings? Teacher will review journal entries to assess learning.



Lee's Summit ISD in Missouri switched to an electric vehicle fleet and now pays 11 cents per gallon compared to $3 previously.

Facing Page: Klein ISD Transportation Center
Serves 70 School Buses

transportation *at a glance*

- ☑ Make it easier for students to bicycle, walk, or jog to school.
- ☑ Support carpooling.
- ☑ Encourage use of public transportation.
- ☑ Develop an incentive program for students and staff to use transportation alternatives.
- ☑ Buy alternative fuel vehicles.
- ☑ Maintain school buses adequately.
- ☑ Transition school buses to alternative fuels.
- ☑ Make your school pedestrian-friendly.

TRANSPORTATION

TRANSPORTATION

sources contribute more than half of the man-made air pollution in the United States today. Motor vehicle emissions account for approximately 77 percent of the carbon monoxide (CO), more than 36 percent of the volatile organic compounds (including hydrocarbons), and 45 percent of the nitrogen oxides (NOx) in our nation's air.[31]

OIL EXTRACTION

lays waste to many fragile ecosystems, harming tropical forests in South America and Southeast Asia, deserts and wetlands in the Middle East, mainland US coastal areas, and the fragile tundra and arctic coastal plains of Alaska.

Alternative Transportation

Follow these steps to reduce the transportation impact of your school — this will reduce air pollution, water pollution, and consumption of fossil fuels.

Make it easier for employees and students to bicycle or walk to school.

- Provide a bike rack for staff and students.
- Provide showers.

RULE OF THUMB:
Prohibit the idling of cars and buses, and the use of cellphones in the carpool lane

Support carpooling.

- Provide incentives for staff, students, and parents to organize carpools.
- Reserve preferred parking spaces near the building entry for carpools.

Encourage use of school bus lines.

- Post a transit map indicating nearby transit lines and schedules.
- If free parking is provided, subsidize transit costs.

- For example, Kirksey provides a free lunch for every five days an employee uses alternative transportation to travel to work.

Calculate your CO_2 Emissions at these websites:
http://www.epa.gov/climatechange/index.html
www.earthday.net/footprint
www.nature.org/initiatives/climatechange/calculator/

Fuel Economy Websites:
US DOE and EPA website about auto fuel economy, emissions, and air pollution: www.fueleconomy.gov
Alternative Fuels Data Center: http://www.afdc.energy.gov/afdc/

When purchasing vehicles for the district, select highly fuel-efficient or alternative fuel vehicles.

- Alternative fuel vehicles
- Hybrid gas-electric
- Electric
- Compressed natural gas
- Biodiesel

Make maintenance a priority for district vehicles.

Make the space around your building pedestrian-friendly.

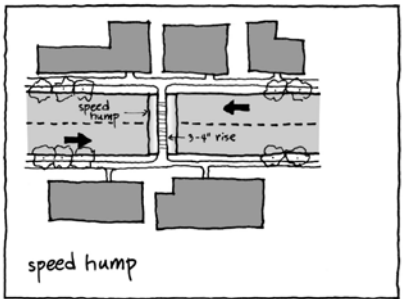
- Provide well-marked and lighted walkways with awnings if possible.
- Keep parking areas to the rear.
  - If you have a complex of buildings, use traffic-calming measures. This will make foot travel much safer. Typical measures include the illustrations on the following page:

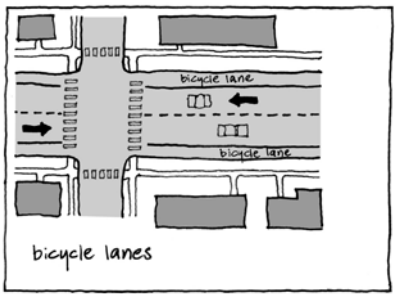
SAVE FUEL & MINIMIZE EMISSIONS

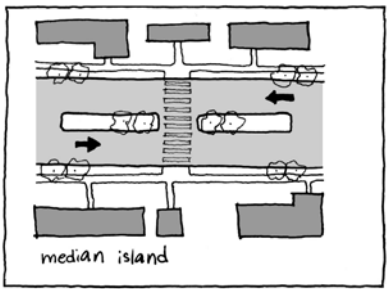
The Top 4 Things You Can Do:

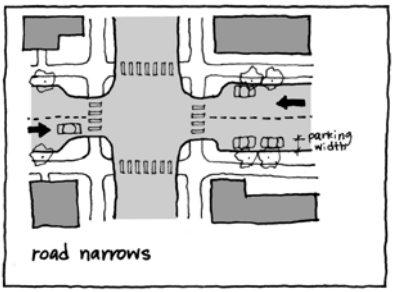
- Have vehicles serviced regularly according to manufacturer recommendations.
- Properly inflate your tires.
- Don't top off the gas tank.
- Purchase low-octane gas unless the manufacturer recommends otherwise.

Make Your School Pedestrian Friendly









TRANSPORTATION LESSON

How can I spend less time in a car?

Engage:

The teacher will display a map of the area that includes the homes of all the students in the class. Students will locate their homes on the map and outline the route that they take to school.

Explore:

Students will calculate and categorize the distance that they walk, bike, drive or take the bus to school. For car and bus students, they will approximate how many gallons of gas it takes to travel this distance.

Explain:

Students will discuss how different vehicles use different types of fuel and are more or less efficient based on the type of vehicle.

- What is a hybrid vehicle?
- What are alternate types of fuel?
- How does the size of a vehicle affect its fuel efficiency?
- How does the speed of a vehicle affect fuel efficiency?

Elaborate:

Teacher and students will discuss the advantages and disadvantages of using alternate-powered vehicles and alternate means of getting to school. What things would they have to change to make these adjustments? (Examples: electric cars will need power charging stations, streets to schools would need safe sidewalks, etc.)

Evaluate:

Students will create a strategic plan for their classroom that shows how — as an individual, as a family and as a class — they can reduce the amount of fuel they use to get to school. Calculate how much fuel might be saved by devising a carpool program, and or by walking, biking, or taking the bus to school.

HOUSEKEEPING

Pound for pound, children take in proportionately greater amounts of environmental toxins; rapid development also makes them more vulnerable to environmental interference. Implementing a Green Cleaning program can drastically reduce their exposure to toxins.

Facing Page: Parish School
Communal Learning Area

housekeeping *at a glance*

- ☑ Use non-toxic cleaning fluids.
- ☑ Clean carpets frequently.
- ☑ Don't strip and wax floors too often.
- ☑ Use an entryway walk-off system.
- ☑ Start a recycling program.
- ☑ Reduce waste.
- ☑ Use recycled-content products.
- ☑ Protect ductwork during renovation.
- ☑ Suppress dust.
- ☑ Prevent mold growth.
- ☑ Isolate construction areas.
- ☑ Use low-emitting materials.

HOUSEKEEPING

Cleaning

Unclean carpets capture a variety of particulate matter. Fine particles smaller than 2.5 microns in size are easily inhaled deeply into the lungs where they can remain embedded indefinitely.[32]

Use non-toxic cleaning solutions to protect the health of teachers, students and custodial staff.

- Use Green Seal (www.greenseal.org) certified cleaning fluids, detergents and soaps. They must meet stringent guidelines, including the following:
  - Minimal toxicity to human and aquatic life
  - Biodegradability
  - Minimal phosphates and no heavy metals

Care for carpets appropriately.

- Vacuum every 2-3 days in low- to medium-traffic areas.
- Use vacuum cleaners that meet the Carpet and Rug Institute (www.carpet-rug.org) Green Label standard, or that have HEPA

GREEN HOUSEKEEPING PRODUCTS USED BY KIRKSEY

(all of the following have Green Seal certification)

- Enviro Care, Low Foam All-Purpose Cleaner
- Enviro Care, Glass Cleaner
- Enviro Care, Neutral Disinfectant
- Enviro Care, Washroom Cleaner
- Green Solutions, Glass Cleaner
- Green Solutions, Neutral Disinfectant Cleaner
- Green Solutions, Carpet Cleaner

(High Efficiency Particulate Air) filters. They can remove smaller particles that can otherwise become airborne and enter the lungs.

- Check for spots daily and treat immediately. Start by blotting with water and cloths, and then move on to stronger chemicals only if needed.
- Perform carpet extraction regularly using equipment capable of removing enough moisture for carpets to dry in 24 hours.

Train maintenance staff to care for building finishes appropriately.

According to the US Bureau of Labor Statistics, 127 custodians were killed by cleaning products between 1993 and 2001.[33]

- Make sure not to overuse detergent; this causes finishes to wear out prematurely.
- Follow recommended maintenance procedures for floor finishes. Many floors are stripped and waxed much more frequently than necessary; this releases toxins and is energy-intensive.

Protect occupants with an entryway walk-off system to capture dirt and particulates.

- The EPA recommends a three-part track-off entryway system, consisting of 20 feet of grating and matting. (See figure).

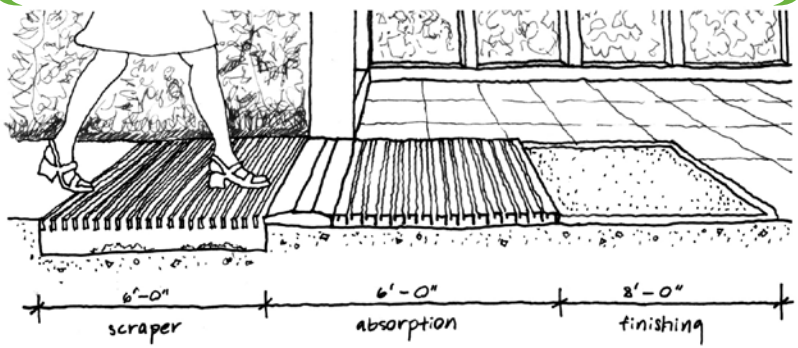
DANGEROUS CHEMICALS USED IN CLEANING SOLUTIONS INCLUDE

- **sodium hypochlorite** (in bleach): if mixed with ammonia, it releases toxic chloramine gas.
- **petroleum distillates** (in metal polishes): can damage the nervous system, skin, kidneys, and eyes.
- **ammonia** (in glass cleaner): can cause headaches and lung irritation.
- **phenol and cresol** (in disinfectants): can cause diarrhea, fainting, and kidney and liver damage.
- **nitrobenzene** (in furniture and floor polishes): can cause skin discoloration, shallow breathing, and vomiting, as well as cancer and birth defects.

1. A scraper mat, grille, or grate installed outside the building.
2. A wiper/absorption mat that scrubs the shoes of people walking across. This stiff-bristled mat is typically in the entrance foyer.
3. A finishing mat installed after the wiper mat to remove residual dirt and dust.

- Provide for easy cleaning of exterior scraper mat or grate. It should be easily hosed off.
- Provide drainage for second wiper mat or grate where practical. Moisture from people's shoes can best be removed by setting the grate into a recessed floor space with drainage.
- Recycled content walk-off systems include the following:
  - Arden Architectural Specialties. **EnvIRONtread II**; http://www.ardenarch.com
  - **Milliken First Appearances** — http://www.firstappearances.com

80% of dirt is tracked into buildings on people's shoes.[34]



The amount of Volatile Organic Compounds (VOCs) emitted from a single waxing of a floor is comparable to the amount of VOCs emitted from the flooring itself over its entire life.[35]

LIFE CYCLE COST ANALYSIS FOR VARIOUS FLOORING OPTIONS

Flooring Type	Installed Cost	Maintenance Cost	Expected Life	20-yr Cost
Epoxy Coating	$1.50 - $5	$1.50	1- 5 yrs	$36 - $50
Sheet Vinyl	$3 - $5	$1.50	9 yrs	$36 - $40
VCT	$1.50 - $4	$1.50	10 yrs	$36 - $41
Carpet	$2.50 - $4	$1.25	5 - 10 yrs	$30 - $33
Terrazzo	$12	$0.60	20 - 50 yrs	$16 - $17
Polished Concrete	$1.50 - $4	$0.25	20 - 50 yrs	$5.6 - 6.6
Porcelain Tile	$4 - $10	$0.40	20 - 50 yrs	$6.60 - $9

For Reference Only: Consult your local product representatives and maintenance providers for more accurate information based on particular product and maintenance requirements.[36]

Waste

Follow these steps to reduce waste in your facility.

Start a recycling program.

- Designate well-marked collection areas for recyclables including newspaper, cardboard, glass, aluminum cans, and plastic.
- Provide office paper recycling bins at each staff member's desk.

Look for ways to reduce waste and re-use resources before recycling.

- Dispose of food waste in central locations; individual desk trash-can liners can then be disposed of less frequently.
- Provide re-usable utensils and tableware in the cafeterias.

THE RECYCLING INDUSTRY

employs over 1.1 million people, generates an annual payroll of nearly $37 billion, and grosses over $236 billion in annual revenues in the US.[37]

Use recycled-content disposable paper products and trash bags.

Search for recycled-content products:

www.calrecycle.ca.gov/rcp/search.asp

The California Recycled Content Product Directory lists products from all over the country.

Minor Renovations

Protect ductwork from dust while occupied spaces are being renovated.

- Follow the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) IAQ Guidelines For Occupied Buildings Under Construction.

Suppress dust.

- Confine indoor cutting and other dust-generating activities to one enclosed area.
- Use wetting agents or sweeping compounds to keep dust from becoming airborne.
- Clean up dust using wet rags, damp mops and vacuum cleaners with HEPA filters.

Prevent mold growth.

Mold growth will often occur when excessive moisture or water accumulates indoors. There is no practical way to eliminate all mold in the indoor environment; the way to control it is to control moisture. This is a high priority in hot, humid climates.

- Keep building materials dry. Take special care with absorptive materials like carpet, drywall, insulation, acoustic panels, ceiling tiles and wood.
- Do not use materials that have been damaged by moisture.

RECYCLED PRODUCTS USED BY KIRKSEY

(all of the following have Green Seal certification)

- **EcoSoft Green Seal Toilet Seat Covers**
  100% recycled content, 20% post-consumer, no pigments, inks, dyes or fragrance
- **EcoSoft Green Seal Toilet Tissue**
  100% recycled content, 20% post-consumer, chlorine-free, high capacity rolls
- **EcoSoft Green Seal Towels**
  100% recycled content, 40% post-consumer, non-toxic, no pigments, inks, dyes or fragrance
- **PittPlastics Déjà Vu Trash Liners**
  30% recycled content

Isolate construction areas from occupied areas.

- Provide a pressure differential between work areas and occupied areas. Work areas should have negative pressure, while occupied space should have positive pressure. Make sure that dropped ceilings in the construction area are not operating under negative pressure.
- Install air-tight barriers between work areas and occupied areas. Prevent foot traffic between them.
- Do not store construction materials in occupied areas.
- Temporarily seal transfer ducts, pipe chases, electrical chases and other openings with polyethylene sheeting.

Use low-emitting materials.
Low-emitting materials release minimal Volatile Organic Compounds (VOCs). VOCs are carbon compounds that readily become gas at room temperature.

GREEN SEAL REQUIREMENTS FOR LOW-VOC PAINT

	Interior	Exterior	Anti-Corrosive
Flat	50 g/L	100 g/L	250 g/L
Non-flat	150 g/L	200 g/L	250 g/L

A paint can be labeled "No VOC" if it contains less than 1 g/L, determined using EPA Reference Test Method 24.

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT REQUIREMENTS FOR LOW-VOC ADHESIVES

Carpet	50 g/L
Carpet pad	50 g/L
Wood flooring	100 g/L
Ceramic tile	65 g/L
Drywall	50 g/L
Subfloor	50 g/L
Rubber flooring	60 g/L
VCT flooring	50 g/L
Cove base	50 g/L

South Coast Rule #1168, amended 7 January 2005

- **Select low-VOC paint**
  - All oil-based and most water-based paints off-gas VOCs after the paint is applied. As the paint dries, the solvent that holds the pigment and resin together evaporates. Low-VOC paints that compare well to premium paints include:
    - Benjamin Moore **Pristine EcoSpec**
    - Sherwin-Williams **Harmony**
    - PPG **Pure Performance**

Select low-VOC adhesives and sealants. (See chart).

Specify low-emitting carpets.

- Choose carpets that meet or exceed the requirements of the Carpet and Rug Institute's (www.carpet-rug.com) Green Label or Green Label Plus Indoor Air Quality Test Program. Green Label Plus is a more stringent standard.

Select low-emitting composite wood products.

Use composite wood and agrifiber products that contain no added urea-formaldehyde resins.

- **Plywood** — Urea-formaldehyde-free plywood can usually be purchased for a less than 5% premium over typical plywood.
  - Columbia Forest Products **PureBond**
  - Panel Source Plywood Purekor
- **MDF** — Urea-formaldehyde-free MDF can be bought for a 25-30%

EXPOSURE

to wood dust has long been associated with a variety of adverse health effects, including dermatitis, allergic respiratory effects, mucosal and nonallergic respiratory effects, and cancer.[38]

Mold exposure can cause stuffy nose, wheezing, and eye and skin irritation. It also may exacerbate respiratory allergies in people with asthma and cause mold infections in people with suppressed immune systems.[39]

premium over typical MDF.

- Panel Source MDF **Purekor**
- Sierra Pine **Medex** and **Medite II**

- **Particleboard**
  - Roseburg **Skyblend**. This is a wood-based particleboard with recycled wood fibers. The cost is approximately twice that of typical particleboard.
- **Sierra Pine Encore**
- **Agricultural Fiberboard** — These urea-formaldehyde-free boards are made from wheat straw, a renewable material. There is a small premium for agricultural fiberboard board over traditional particleboard.
  - Environ Biocomposites **Biofiber Panels**
  - Meadowood Industries **Meadowboard**

The EPA considers formaldehyde a probable human carcinogen. Short- and long-term inhalation exposure to formaldehyde can result in respiratory symptoms, and eye, nose, and throat irritation. Studies report an association between formaldehyde exposure and lung and nasopharyngeal cancer.[40]

COMPOSITE WOOD MANUFACTURER WEBSITES:

www.choosecolumbia.com
www.panelsource.net
www.sierrapine.com
www.rfpco.com
www.environbiocomposites.com
www.meadowoodindustries.com

CLEANING LESSON

Get it Clean. Keep it Green.

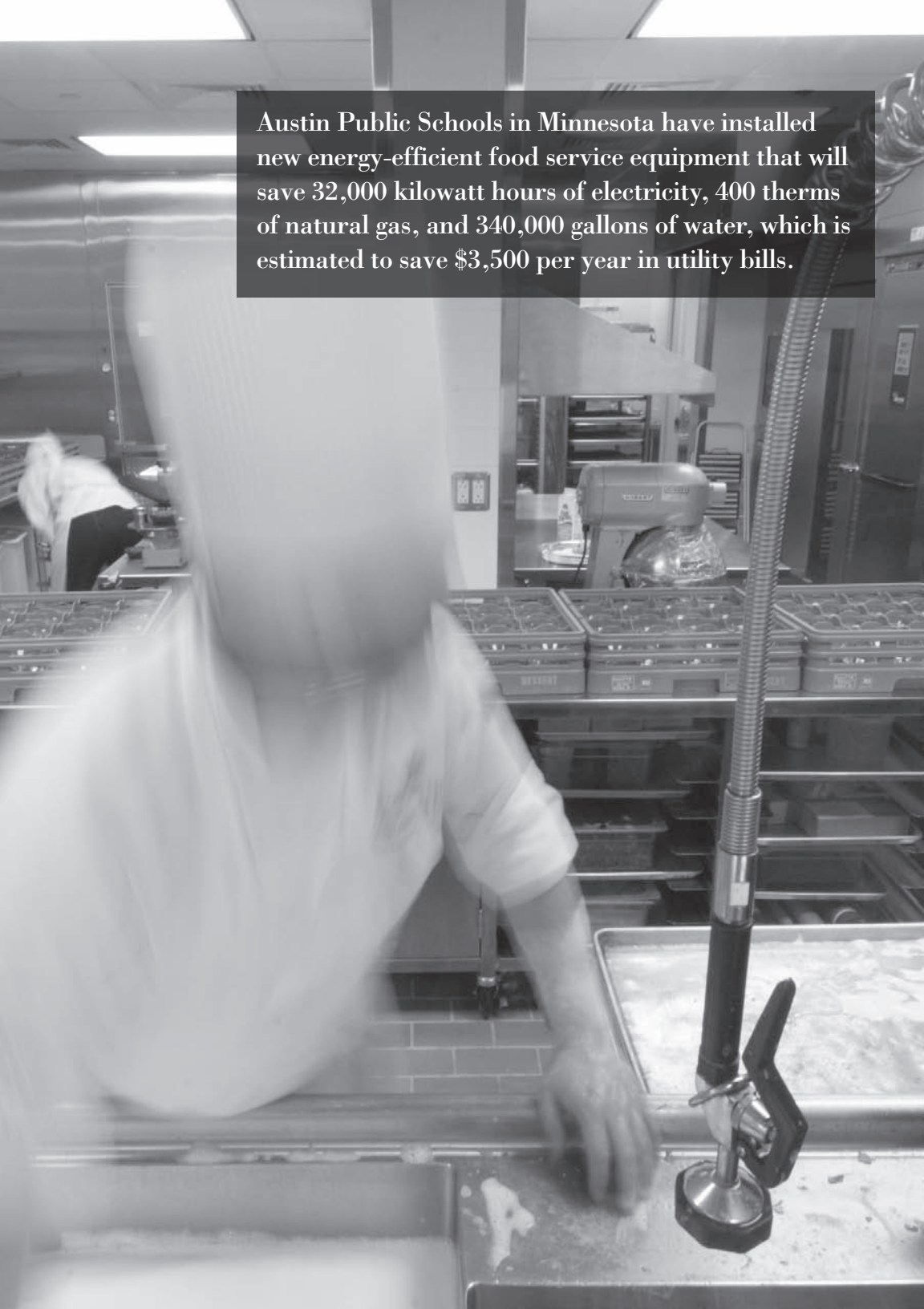
Engage:
Over the course of a few weeks, students will collect empty cleaning bottles which have been rinsed and still have labels intact. The teacher will display these bottles of typical household cleaning products, eco-friendly cleaning products, and several brands of white vinegar and baking soda. Teacher to provide a chart showing wastewater from the drain to the communal water system and eventually back to the environment.

Explain:
Students will discuss the items on display and read the labels of the different products. What do these products have in common? Which products might be safer for humans and why? Which products might be safe for animals? Discuss how they use these products and how they might end up in the ecosystem. When they use these products, how might they affect the air they breathe?

Explore:
Students will explore making their own safe cleaners, learning about parts, volume, and process of dilution by creating different strengths of cleaning solutions using vinegar & water and baking soda & water. Students will carefully document the success of their cleaners based on their composition.

Elaborate:
Students will do further research on what makes up vinegar and baking soda and what other organic products are good for cleaning.

Evaluate:
For their new cleaning product, students will create a label, listing the ingredients and the percentages of each and describing where the cleaner may be used with a list of any cautions. The label should describe why the cleaner is safe for the environment. Time permitting, students should design a graphic or logo for their product that they feel will encourage someone to use their safe household cleaner.



Austin Public Schools in Minnesota have installed new energy-efficient food service equipment that will save 32,000 kilowatt hours of electricity, 400 therms of natural gas, and 340,000 gallons of water, which is estimated to save $3,500 per year in utility bills.

Facing Page: Kitchen, Sysco Corporate Headquarters
LEED Gold Certified

kitchens
at a glance

- ☑ Purchase Energy Star-rated equipment and appliances.
- ☑ Regularly maintain, retrofit and upgrade existing equipment and fixtures.
- ☑ Ensure that your dishwasher is both energy- and water-efficient.
- ☑ Use "highly-efficient" fume hoods.
- ☑ Install low-flow, high-pressure faucets and rinsers.
- ☑ Start a composting program.
- ☑ Purchase products made with recycled content.
- ☑ Utilize safe, bio-based chemicals for cleaning.
- ☑ Take time to properly train staff.

Energy-Conserving Equipment

Per square foot, a school's kitchen consumes more energy than any other space in the building.

ENERGY USE INTENSITY:
EUI is a unit of measurement that describes a building's energy use and represents the energy consumed by a building relative to its size.[41]

For your district's new kitchens, you should select and require Energy Star-rated equipment.

- Energy Star is a program run by the Environmental Protection Agency (EPA) that rates the electrical consumption of various types of appliances and equipment, and then designates "Energy Star" to those in the top 25%.

- The following types of commercial equipment have been rated by the program:

- Dishwashers
- Refrigerators and Freezers
- Ovens
- Ice Machines
- Fryers
- Griddles
- Steam Cookers
- Holding Cabinets

ENERGY STAR HISTORY

In 1992, the US Environmental Protection Agency (EPA) introduced ENERGY STAR as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions. Computers and monitors were the first labeled products. In 1995, the EPA expanded the label to encompass additional office equipment and residential heating and cooling equipment. ENERGY STAR provides a trustworthy label on over 60 product categories (and thousands of models) for the home and office. These products deliver the same or better performance as comparable models while using less energy and saving money.[42]

For your district's existing kitchens, ensure routine maintenance. Retrofit and upgrade outdated equipment.

- Simple practices such as cleaning condenser coils, changing filters, and checking gaskets do not take long and can contribute to both energy savings and equipment life.

- Incorporate new technologies as they become available, such as strip curtains for walk-in refrigerators, variable-speed drives for fume hoods, and low-flow aerators for faucets and spray valves.

Fume Hoods are not only high consumers of energy, but are also a significant draw on your school's HVAC system.

- Types of Highly-Efficient Fume Hoods
  - Dry Extractor - 90% efficient
  - Water Wash - 98% efficient
  - UV - 99% efficient

FUME HOODS

Turning all of the hoods on in the kitchen is a very energy-consumptive practice.

Variable-speed, particle-detecting, and proxy demand control are new technologies that regulate the flow of air through the hood based on demand rather than constant volume.

This uses less energy and minimizes the amount of air to be heated and cooled.

By implementing the SCORE program, sponsored by SECO and CenterPoint Energy, your district may receive funding to implement many of these energy-saving strategies. www.energyefficiencyprograms.net

To reduce the fossil fuels used for water heating, consider Solar Thermal systems such as a Passive Thermal Siphon, which can be mounted to a roof or canopy.

KITCHENS

Water

Follow these steps to reduce the water consumption in your kitchen.

Install low-flow, high-pressure pre-rinse sprays and faucets.

- A typical pre-rinse spray consumes 2.5 - 4 gallons of water every minute. By reducing the flow to 1 gallon @ 60 psi, you save at least 720 gallons for every 8 hours of rinsing.
- For hand washing sinks, a 0.5 gallon per minute flow rate is acceptable and saves 2 gallons every minute.

When possible, avoid pre-rinsing dishes prior to putting them into the dishwasher. Scrape food into a compost bin or garbage disposal and use water only when necessary.

Use foot pedals for operating faucets and sprays.

- This eliminates faucets that are left on for extended periods.
- These valves are more conveniently located and allow for hands-free access to water.
- They can be installed straight to the floor, on a shelf, or from a wall, allowing them to be highly flexible.

Re-circulate water by reusing rinse water to pre-rinse or wash dishes.

A food service facility in North Carolina documented that they saved 3,700 gallons every month after they installed foot-actuated faucets.[43]

Require water-efficient ice machines and dishwashers.

- Reducing the water used to create ice and wash dishes will save energy by requiring less electricity and gas to freeze and heat the water.

- Look for air-cooled ice machines that reduce the number of gallons of water per 100 pounds of ice from 150 to 25 or 30 gallons. Energy-wise, air-cooled machines use between 2 - 4 kWh less per 100 lbs of ice.

Because of water shortages, San Antonio and Austin, Texas are among several major cities who have banned water-cooled ice machines.

- Purchase Energy Star-rated dishwashers. These machines must use no more than 0.54 - 1 gallon of water per rack to be considered "high efficiency" for water use.

- Install an "electric eye"to ensure that conveyors are working only when necessary to save water and energy.

- Run the dishwasher only when there is a full load because you will consume the same amount of energy and water whether you are washing one spoon or the entire rack.

TO REUSE OR NOT TO REUSE?

One of the biggest decisions a school makes is whether to use reusable trays and silverware. Studies are inconclusive as to whether it is better for the environment to wash dishes and trays (thereby consuming water) or to simply throw them away everyday. It is typically less expensive to use disposables, but not by much.

The issue really is "what do we want to be teaching our kids?" Many educators would agree that teaching children to be responsible for themselves and our resources is a critical life lesson.

KITCHENS

Waste

There are many strategies to keep kitchen waste out of our landfills.

Use re-usable trays and silverware.

- Disposable trays account for a rather high carbon footprint because of the constant manufacturing required.
- If disposable trays are necessary, please consider the following:
  - Avoid PolyStyrene (EPS). It is made from fossil fuels, is non-biodegradable, and rarely recycled. It is also a known neurotoxin and carcinogen.
  - Look for compostable or biodegradable paper-based trays that are made with recycled content.

In 2006, Henry David Thoreau Elementary School in Seattle switched from EPS to durable lunch trays. The school reduced its solid waste by 82 percent. The switch reduced lunch waste from 6.5 cubic yards to less than 1.2 cubic yards per week.[44]

Provide an area for composting of food waste and other disposables.

- Compost can become great fertilizer for your school's landscape and school garden.
- By using a pulper instead of the garbage disposal, the food waste that normally goes down the drain can be put to good use.
- Composting makes your regular recycling easier by taking care of the portion of the waste that is typically the messiest.

Set up a recycling program to properly dispose of the boxes and bins in which food is delivered.

- By using a cardboard bailer, you can sell the cardboard to distributors or others.
- Glass, plastic, and metal containers should be properly disposed of with the rest of the school's recyclables.

WHAT CAN I COMPOST?

YES!	NO!
Food Scraps (Vegetables, Meat, Bones)	**Plastic of Any Kind**
Coffee Grounds & Filters	**Wax or Poly-Coated Paper:** Red & White Soda Cups, Soup Containers, Coffee Cups
Tea Bags	**Most "Take-out" Boxes**
Flowers & Plants	**Foil or Metal**
Pizza Boxes	**Glass**
Compostable Serviceware (Bio- or Paper-Based): Plates, Utensils	**Chemicals**
Fiber-based Containers	**Restroom Waste**
"PLA" Cups & Containers Paper Trays, Paper Towels, Paper Napkins	

WHY SHOULD I COMPOST?

Composting reduces the amount of waste each of us sends to the landfill. In fact, up to 30% of the material we send to landfill is organic and could be composted.

Composting has other benefits, too. Applying finished compost returns nutrients to the land, holds moisture in gardens and on lawns, contributes to watershed health by controlling run-off, and naturally fertilizes and provides structure to the soil.[45]

KITCHEN LESSON

How can I reduce my Carbon Footprint?

Engage:

Teacher creates a pie chart showing the relative carbon footprint for the countries listed below, and displays a map of each country. Have students figure out the country by its shape and select the piece of the pie that equals that country's carbon footprint. [USA 19, Australia 18, England 10, Germany 9, Italy 8, France 6, Sweden 5, Nigeria 0.7, Sudan 0.3, Kenya 0.3, Congo 0.4, Uganda 0.1, India 1, Chad 0, Mali 0]

Explain: Discuss what a carbon footprint is and how it is determined.

Elaborate: Take a look at two appliances — one Energy Star and one that is not. Energy Star appliances have yellow tags on them describing the energy they will consume during a year. Have students check to see if they have Energy Star appliances at home.

Explore: Have the students explore how much carbon is created in the process of making 1 KWH of electricity using Coal and Natural Gas. State-based figures from the Department of Energy's Energy Information Administration show that on average, electricity sources emit 1.297 lbs CO_2 per kWh. There are 12.0593 pounds CO_2 per CCF of natural gas according to US DOE 1605(b) Voluntary Reporting of Greenhouse Gases Program.

Evaluate: Each year, a typical American is responsible for approximately 19 tons of carbon dioxide emissions. Have the students go online and use a carbon calculator to determine their own carbon footprint. Have your students compare themselves to the average American, then have them compare themselves to the average European, Australian, Indian (not native American) and African. Discuss as a class.

Carbon Footprint Calculator
http://www.carbonfund.org/Calculators#Home

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