2. Plunging In: The School Water Audit - The Inventory

How can we begin to characterize School Water Use?

**Summary:**
Students will develop a vision for the School Water Audit through conducting an inventory of indoor and outdoor water use. They will also begin to research water use technology as background information for future decision-making.

**Objectives:**
Students will:
- Brainstorm water uses at school
- Categorize water uses based on school property layout
- Map water-use locations
- Make qualitative observations of water use
- Research water use technology

**Materials/Supplies:**
**Activity**
Per student group:
- One building plan or indoor map of the school property. See *Sample School Building Plan/Indoor Map* (Appendix 2.A)
- One outdoor map or aerial view of the school property (ask administrators or use Google Earth) (See *Sample Map of the School Grounds* in Appendix 2.B)

- Two clipboards
- Optional – one digital camera

Per student:
- One SWAP Inventory Guide (Appendix 2.C)

**Wrap Up**
- Water Savers’ Mystery Box (Appendix 2.D)

**Background for Teachers:**
**Facts relative to institutional water use:**
Institutional water use includes: 1) indoor domestic uses (restrooms, kitchens, and laundries), 2) cooling and heating, and 3) landscape irrigation. All institutions can save water by evaluating how much water they consume, implementing water conserving procedures, and converting to water saving fixtures. Three primary areas of water savings include:
- Reducing losses by fixing leaky faucets and pipes.
- Reducing consumption by installing ultra-low-flush toilets, automatic shut-off faucets, and/or eliminating once-through cooling process equipment.
- Reducing outdoor water use by modifying existing landscaping to incorporate...
native and drought tolerant plants that require less irrigation water, installing irrigation controllers that respond to actual water demand, and/or installing rainwater collection systems that collect and store roof runoff for irrigation.

Making qualitative vs. quantitative observations

Qualitative observations are descriptions that do not use numbers. For example, if you report colors, smells, tastes, textures, or sounds, you are using your senses to make qualitative observations. Quantitative observations are made with instruments such as rulers, balances, graduated cylinders, beakers, and thermometers. These results are measurable. If you count objects or measure them with standard units, you are making quantitative observations.

Science is an iterative or repetitive process.

This project is designed to model the way scientists approach a question or problem in the real world. The students will arrive at the answer to the background question, “how much water do we use at school?” by making iterative forays into direct observation data measurement and information searches, refining their estimate with each pass.

Observation vs. inference:

Observations are statements of knowledge gathered by one’s senses. Inferences are educated guesses, assumptions, interpretations or conclusions derived from observations. When students struggle with making observations, they may resort to making inferences without realizing it. For example, students may observe a wet spot on the ground under a water fountain and report that the water fountain is leaking. “There is a wet spot” is an observation. “The water fountain is leaking” is an inference. Making good inferences is very important.

Good scientific evidence is:

- information gained by means of observation, experience, or experiment,
- well-documented (in writing, with photos),
- detailed,
- objective, and
- not an inference.

Preparation before the activity:

- Optional: have students practice making detailed observations and distinguishing between observations and inferences.
- Brainstorm your own list of school water uses.
- Notify school administration and facilities management at your school and the school district that students will be
conducting the inventory and later audit of school water use.

- Acquire school maps. See *Sample School Building Plan Indoor Map* (Appendix 2.A) and *Sample Map of the School Grounds* (Appendix 2.B)

- Acquire keys, permissions, etc. as necessary to access locations that are typically off-limits to the students.

- Schedule staff or community volunteers (parents, PTA, school board, local water company) to accompany student groups as they tour the school.

**Lesson Procedure:**

**Warm up:**

Present the big picture focus question:

*How can we reduce water use or use water more efficiently at school?*

Recall the decision-making process defined for the Home Water Audit. A similar process will be used for the School Water Audit. Since the SWAP is a larger and more complex undertaking, the previously defined process needs some refinement. Instruct the students to copy this revised process into their notebooks. Post a large, easily referenced copy of this process.

1. Assess the situation / gather background information
2. Gather data
   a. How often do we use water?
   b. How much water do we consume each time we use it?
3. Arrange and analyze the data
4. Synthesize data and background information
5. Draw conclusions
6. Recommend or propose a course of action.

**Activity:**

1. Brainstorm school uses of water.
2. Rewrite the list, grouping the water uses into Indoor and Outdoor water use regions. Sub-categorize further according to specific indoor areas and outdoor areas as they pertain to your school setting (i.e. cafeteria, science building, east-side lawn, center patio, etc.). Water uses should be listed in each region where they are found. The list should be posted in the classroom.
3. Add campus regions that are missing from the list and mark.

**List of Water Uses**

*Example*

1. Drinking
2. Flushing toilet
3. Washing hands
4. Preparing food
5. Washing dishes

**List of Regions (indoor and outdoor) Example**

1. Cafeteria
2. Bathroom
3. Drinking Fountains
4. Football or Soccer field
5. Inner courtyard
6. Baseball or Softball Field
them as having no apparent water use. These will be inventoried during the tour as well as the water-use areas.

4. Explain that the brainstorming activity is the beginning of the inventory of the school’s water uses. Students will complete the inventory by touring the school, mapping the water use locations, and documenting their observations.

5. Assign each cooperative group to a campus region from the list of areas to inventory.

6. State the rules and expectations for making good observations. Observations should include a mapped location (using a symbol from a map legend), number of fixtures, a written description i.e. qualitative observation, a class period, date, and team recording data.

7. Hand out the SWAP Inventory Guide (Appendix 2.C) and actual maps of the school grounds and the school buildings to the appropriate teams.

8. Collaboratively decide on a legend for marking the maps. You will need symbols for sprinkler heads, drip emitters, bubblers, faucets, toilets, urinals, drinking fountains, other-indoor uses, and other-outdoor uses.

9. Instruct the students to mark every water use on their map. Look for and document leaks, unexpected water uses, signs of misuse or abuse, and make good qualitative observations of regular use. Tie written observations to locations by numbering the observations and writing the corresponding number on the map at the location where the observation was made. Encourage students to include sketches or photos if possible.

10. After the tour and inventory, extra time may be needed for groups to finalize their observation writing or drawings.

11. Transfer the symbols and numbers referring to observations to an enlarged indoor map and an enlarged outdoor map posted on the wall or bulletin board. These will serve as master maps for the entire class data set.

12. Add to the original brainstormed list of water uses any unexpected water uses that were found, the numbers of each type of water use (i.e. number of toilets, number of sprinkler heads in the ball field), and any other details that the students feel will make the list more complete and useful.

Wrap-up
Return to the problem solving process description and point out your current location in the process i.e. just at the end of the “assessing the situation” phase. This is a good time to start gathering background information relative to the workings.
of the current water use system and potential improvements to the system.

**What are more efficient options for water use?**

Remember the difference between behavioral solutions and technological solutions?

Ask students to report on the conservation measures that they had selected for their home water use. Have their family members agreed to participate? Are they still committed to those measures? Those conservation measures are behavioral solutions.

Introduce the *Water Savers’ Mystery Box*, a collection of unidentified technological solutions (See Appendix 2.D for a listing of objects. A Mystery Box may be obtained through your local Arizona Cooperative Extension office).

1. Divide the class into cooperative groups of 2-4 students.
2. Have one student from each group cover their eyes and select one item from the box.
3. Instruct each group to examine the item and brainstorm its purpose as well as how it can be used to save water.
4. Have each group report on their conclusions.
5. Allow students from other groups an opportunity to add to the information.
6. Use Water Savers Mystery Box descriptions in Appendix 2.D to fill in the gaps in student knowledge.

Assign research project: have each student select one water use from the brainstormed list of current uses and research it via the website, “How Stuff Works” at [http://www.howstuffworks.com/](http://www.howstuffworks.com/).

Pre-print articles for students who do not have internet access.

Questions to address via the research:
- What hardware or fixtures are employed for the assigned water use?
- How do those fixtures work? How do they fail?
- How would you repair a failing fixture?
- What alternatives exist that might be more water-use efficient?

Results will be needed by the end of the third data collection activity so that they can influence the final recommendations.

**Assessment via Notebooking/journaling:**

Ask students to reflect on their inventory and tour experience.

- Were they surprised by anything that they or their classmates observed?
- Are there any water uses, water leaks, or water misuses at school that were not listed or added to the inventory?
• Based on the inventory and what they know about water use at school, where do they expect the largest water use to be found?
• Where might the greatest water savings be made and what changes will be required to make those savings happen?
• Ask the students to gather into groups other than their cooperative groups to share what they have written.
Appendix 2.A
Sample School Building Plan / Indoor Map

Name: ___________________  Group #: _________  Period: ____________  Date: ____________
Appendix 2.B

Sample Map of the School Grounds

Name: ___________________________  Group #: _________  Period: ___________  Date:_________
Appendix 2.C

SWAP Inventory Guide

Making detailed, qualitative, observations of school water use:

- Tour entire assigned region of the school.
- Observe water use, looking for evidence of “breaks” in the system or blatant misuse (leaks or carelessness) as well as the characteristics of “appropriate” use.
- Write descriptive details such as when, where, how, why, including environmental factors, and extenuating circumstances that may influence water use.
- Document technical details about fixtures that can help with further information research i.e. number and type of fixtures, manufacturer’s name, and any identifying numbers printed on the fixtures.

Tips for observing water use:

- Listen! Put your ear near fixtures and listen for running water.
- Touch. Feel along water pipes for water wicking along a surface. Remember hot water pipes can be hot!
- Look. Under, up close, behind things. If you see corrosion or mineral build-up you’ve discovered a potential leak.
- On landscaping, look for dry vs. green variations that might indicate irrigation problems.
- Step. Be aware of the texture of the ground that you walk on. Squishy ground is more wet than hard ground and may imply a problem.
- Look for water in unexpected places i.e. up high (misters, evaporative coolers and overhead sprinkler systems) and down low (refrigeration cooling run-off, rain gutters).
Appendix 2.D

Water Savers’ Mystery Box

- Water Meter – A water meter is a gauge that measures water use. If you want to assess whether there is a leak at your house using your water meter; you can check it once before the whole family leaves one day and, if no automatic water use was on while you were gone, it should be the exact same reading when you return. If not, you have a leak.

- Faucet aerator – lowers the amount of water coming out of your faucet each minute by mixing in air. If an aerator is already installed on your faucet, it will have its rated flow imprinted on the side. This should read 2.75 gpm (gallons per minute) or lower. Replace if the new aerator lowers the faucet flow. If no aerator is installed, check to see if there are threads just inside the tip of the faucet. Most modern faucets are threaded to accept aerators.

- Toilet Tablets – are used to check for leaks in toilets with a tank in back. Put the tablet in the tank. If you have a leaky flapper you will see dye in the bowl of your toilet. The toilet flapper needs replacing.

- Toilet Tank Float - Another way that your toilet can leak is through the over flow tube. If your float is set too high this may also cause leakage. The float is easily lowered by hand.

- Toilet Flapper – moves up and allows water in the tank to replace the water flushed from the toilet bowl. The flapper then seals so the tank can fill up with water again. To learn how to replace a flapper, go to: http://www.masterplumber.net/how_to.htm.

- Low Flow Shower Head – uses less water at a higher pressure than a traditional shower head. To test shower head flow, set a 2 quart saucepan on the shower floor and position it in the middle of the shower stream. With the shower on full, count how many seconds it takes to fill the pan. If it takes fewer than 12 seconds, you could use a low-flow shower head. If you have a low-flow shower head installed, it should read 2.5 gpm or less.

- Catch cans – are used to measure irrigation uniformity, how evenly you apply water over a turf area.