This presentation premiered at WaterSmart Innovations

watersmartinnovations.com
Using Project Based Learning to Promote Water Efficiency on School Grounds

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Arizona Project WET - History

- 1989 third state to pilot Project WET lessons
- 1995 Project WET Curriculum & Activity Guide published with assistance from USBR
- APW developed the Arizona Project WET Handbook and began delivering water education programs prior to the 1995 PW Guide
Arizona Project WET Develops Water Stewardship and STEM Learning through:

- Teacher professional development that evolves instructional practices and deepens content knowledge
- Direct student outreach that is embedded in or extends in-classroom instruction
- Community engagement with volunteers
Our Primary Water Conservation Programs

- SWAP: School Water Audit Program
- WSI: Water Scene Investigation

Other Popular Programs

- Aqua: STEM Program
- Teacher Academies
- AWF: Arizona Water Festival
Driving Question: How can we reduce water use or use water more efficiently at schools?

School Water Audit Process

Indoors
- Structured Inquiry: Bathroom Faucet Audit
- Guided Inquiry: Classroom Faucet Audit
- Guided Inquiry: Cafeteria Audit
- Student-driven inquiry: Student-selected Audit

Outdoors
- Structured Inquiry: Athletic Field Audit
- Guided Inquiry: Irrigation Audit
- Student-driven Inquiry: Student-selected Audit

Evaluate
- Resurfacing: Communicate Data, Conclusions, Recommendations
STEM education that incentivizes school and community water conservation through student-driven inquiry and students acting to install technology that saves water or recommend water savings initiatives.
Water Scene Investigations

2-day in-classroom presentation by APW Coordinators, inspires participants to adopt home water conservation practices through the installation of water efficient technology and comparison of their savings with other water users.

Bringing Water Savings Home

Parents learn about water efficient technology!
Bringing Water Savings Home

Water Savings for Andrada

Choose a Group ID to display the group's water savings data. - Choose -

30 members of the group Andrada have reported their water savings. They will save a total of 127,922.40 gallons per year (gpy) of water because of their Water Scene Investigations.

Yearly Water Savings for Your Group: Andrada
(gallons per year)
Phoenix WSI Program

- 196 Classes Taught
- 5,150 Students Taught
- 2094 aerators changed

![Gallons of Water Saved Annually](chart)
Phoenix WSI Program

49,642,812* gallons saved annually from simple aerator changes!!

* = combined Tucson & Phoenix programs
ARIZONA WATER SUPPLY AND DEMAND

- Groundwater, 44%
- Colorado River, 25%
- CAP, 16%
- In-state Rivers, 12%
- Effluent, 3%

Total Human Demand in 2006 = 6.8 maf*

SW= Surface Water
GW= Groundwater
maf = Million acre-feet
Driving Question: How can we reduce water use or use water more efficiently at schools?

Water Audit Process

Indoors
- Get Their Feet Wet: Home Water Audit
- Plunging In: Indoor and Outdoor Inventory

- Indoor Audit
  - Structured Inquiry: Bathroom Faucet Audit
  - Guided Inquiry: Classroom Faucet Audit
  - Guided Inquiry: Cafeteria Audit
  - Student-driven inquiry: Student-selected Audit

- Outdoor Audit
  - Structured Inquiry: Athletic Field Audit
  - Guided Inquiry: Irrigation Audit
  - Student-driven Inquiry: Student-selected Audit

Outdoors
- Resurfacing: Communicate Data, Conclusions, Recommendations
### Outdoor Water Audit

#### Determining Sprinkler Locations on Athletic Field

<table>
<thead>
<tr>
<th>WEST</th>
<th>NORTH</th>
</tr>
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<tbody>
<tr>
<td>1-A</td>
<td>1-B</td>
</tr>
<tr>
<td>1-C</td>
<td>3-A</td>
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<td>1-H</td>
<td>1-I</td>
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</tbody>
</table>

**Sprinkler head marked with flag**

**Legend**
- **Red Star:** Zone 1-4 sprinklers
- **Blue Star:** Zone 1-5 sprinklers
- **Green Star:** Zone 1-6 sprinklers
- **Yellow Star:** Zone 1-7 sprinklers
- **Orange Flag:** Zone 1-8 sprinklers

**Periods**
- Period 1: Run Zones 4 & 6 together
- Period 2: Run Zones 3 & 7 together
- Period 3: Run Zones 2 & 5 together

**Total:** 29 sprinklers
Catch Can Placement
Calculating Distribution Uniformity

Catch Can Placement:
- Blue square in center is one sprinkler head
- Yellow squares are catch cans, placed at 25 and 50-foot intervals

1 square = 2 feet

13
90 feet
6
14

7
8
9
10
11
12

5
25 feet

4
3

15
16
Running the system

Outdoor Water Audit

Checking the heads

Measuring catch can volume

SWAP
School Water Audit Program
Outdoor Water Audit
Getting Results
Math that means something

5. How does your DU vary from the DU values calculated by the other groups for other sprinklers? Why do they vary?

Class discussion

6. Combine all answers to questions 1 and 2 into one data set. Calculate the overall distribution uniformity (DU):

<table>
<thead>
<tr>
<th>Average of the lowest values:</th>
<th>2.15 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Catch Overall:</td>
<td>3.65 ml</td>
</tr>
<tr>
<td>Overall DU:</td>
<td>2.15 ml = 0.589 x 100 = 58.9 %</td>
</tr>
<tr>
<td></td>
<td>3.65 ml</td>
</tr>
</tbody>
</table>

7. What does this overall DU tell you about how uniformly water is applied to the whole field? The DU tells us that the field is not watered as uniformly as it could be. Though perfection (100%) could not be accomplished without needless expense and overuse of sprinklers, a value of above 80% would indicate very good distribution uniformity.
Outdoor Water Audit
Getting Results

Math that means something

12. Convert the water use calculated in question 10 from inches/year to gallons/year over the entire field.

\[
\text{Water Used} \left(\frac{\text{gal}}{\text{yr}}\right) = \text{Area} \left(\text{ft}^2\right) \times \text{Water Used} \left(\frac{\text{in}}{\text{yr}}\right) \times \left(\frac{\text{ft}}{12 \text{ in}}\right) \times \left(7.48 \text{ gal} \right) \left(\text{ft}^3\right)
\]

\[
\text{Water Used} \left(\frac{\text{gal}}{\text{yr}}\right) = 3000 \left(\text{ft}^2\right) \times 43.21 \left(\frac{\text{in}}{\text{yr}}\right) \times \left(\frac{\text{ft}}{12 \text{ in}}\right) \times \left(7.48 \text{ gal} \right) \left(\text{ft}^3\right)
\]

\[
\text{Water Used} \left(\frac{\text{gal}}{\text{yr}}\right) = 80,863
\]

15. Compare this number to the amount of water being applied to your field each year (the amount calculated in question #12).

\[
\text{Water Used} \left(\frac{\text{gal}}{\text{yr}}\right) = \text{Area} \left(\text{ft}^2\right) \times \text{Turf} \left(\frac{\text{in}}{\text{yr}}\right) \times \left(\frac{\text{ft}}{12 \text{ in}}\right) \times \left(7.48 \text{ gal} \right) \left(\text{ft}^3\right)
\]

\[
\text{Water Used} \left(\frac{\text{gal}}{\text{yr}}\right) = 3000 \left(\text{ft}^2\right) \times 61.94 \left(\frac{\text{in}}{\text{yr}}\right) \times \left(\frac{\text{ft}}{12 \text{ in}}\right) \times \left(7.48 \text{ gal} \right) \left(\text{ft}^3\right)
\]

\[
\text{Water Used} \left(\frac{\text{gal}}{\text{yr}}\right) = 115,828
\]

• Using duration & frequency, they calculate water use in inches per year
• Convert it to gallons per year
• Compare their figures to recommended values from Irrigation Specialists for their area.
Arizona Project WET Resources  https://arizonawet.arizona.edu/

We’re happy to share!
SWAP Curriculum

The SWAP Curriculum was written to inspire student-driven inquiry through a meaningful scientific and engineering process. After the introductory Water Use Inventory, the audit branches to either indoor-focused or outdoor-focused investigations. The first unit of each branch is designed as a teacher-driven unit to teach scientific and mathematical thinking and investigation processes. As the project progresses through each investigation branch, the complexity of the variables that affect the focus questions increase. By the final unit on each side of the flow chart, students are tasked with designing their own inquiry; writing a procedure, data charts and equipment list; and with implementing their investigation. The culminating communication of their School Water Audit findings, water savings, ideas and recommendations is an essential component of this curriculum.
Arizona Project WET Resources  https://arizonawet.arizona.edu/

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SWAP Curriculum

The SWAP Curriculum is effective STEM education that develops student's independence in inquiry as they learn investigation skills and apply them in pursuit of their own understanding and solutions.

Download the complete SWAP curriculum or individual units by clicking on the download links to the right. Also, click on the more information links for insight and guidance from experienced SWAP teachers.

Where might you have seen this resource used?

In conjunction with an APW Program:
- Teacher Academies
- Water Scene Investigation

During a Workshop:
- SWAP

https://arizonawet.arizona.edu/
Any Questions?
Thank You!

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