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THE UNIVERSITY OF ARIZONA
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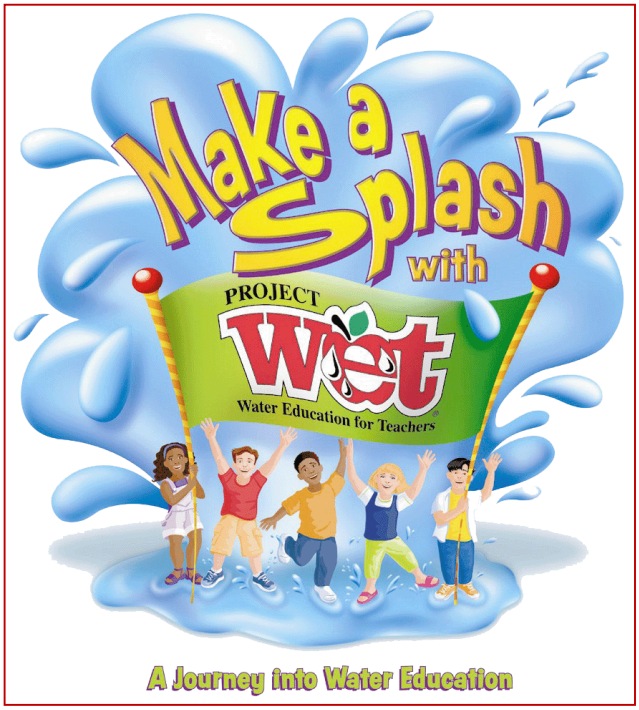

Arizona Project WET Water Festivals:

A Summative Evaluation

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Overview of Activities for the Year

The Make a Splash with Project WET Arizona Water Festival program is in its ninth year and served 12 communities in the 2008-2009 school year. The program trained 622 volunteers to deliver engaging water education to 6,924 fourth graders and their 313 teachers. With the support of the Bureau of Reclamation, Arizona Project WET has conducted a summative evaluation, and will use that information to further increase the effectiveness of the program while simultaneously documenting impacts in student learning and community engagement in water education.

Table 1 2008-2009 Water Festival Numbers

Festival Date	Festival Location	Student Participants	Teacher Participants	Parent Participants	Volunteers
2008					
September 30	Flagstaff	923	42	80	68
October 3	Tucson	875	35	70	50
October 10	Payson	200	9	18	24
October 23	Verde Valley	400	16	32	77
October 24	Sierra Vista	545	25	70	36
November 6	Yuma	450	20	40	32
November 13	Fountain Hills	824	33	55	50
2009					
February 27	Safford	800	28	20	51
April 21	Maricopa	375	36	23	24
April 29	Nogales	574	23	23	47
May 19	San Simon	72	7	0	30
May 27	Chandler	886	39	77	133
TOTAL	**12**	**6924**	**313**	**508**	**622**

Program Overview

Water Festivals are community events that reflect the diversity of Arizona's communities and rally individuals around the important cause of water education for children and water conservation for communities. Teachers, volunteers, sponsors, and students all learn to be better stewards of Arizona's precious water resources through the water festival experience. Four key components (volunteer training, professional development for teachers, the support of community partners, leadership of local coordinators, and an effective educational model) all contribute to the success of the program statewide. All of these components taken together create a dynamic environment in which students are ready to learn, to have fun, and to become better water stewards.

Volunteer Training

A key component of the Water Festival experience is the use of volunteer presenters to teach the interactive lessons of the water festival. This enables us to reach far more students than would be possible in any other scenario and to build a community of facilitators who are invested in water education and better educated themselves about water issues in their region. The corps of water festival volunteers in each community grows year by year, as old volunteers return again and again and new volunteers join the team.

Teacher training

Water Festivals begin with professional development for teachers. Teachers learn about the water in their local region, as well as innovative methods for introducing and reinforcing water concepts to their students. This magnifies the educational power of the water festival, connecting what students learn at the event back to the classroom, and integrating water education into the whole curriculum, using water as a context to practice reading, writing, science, math and social studies skills.

Support and Leadership of Local Coordinators

Arizona water festivals are community events that are embraced by the hosting community. They take on the character of each community through the involvement of local sponsors and volunteers. Each festival is spearheaded by a local water festival coordinator who is supported by the statewide coordinator. Local Coordinators are the backbone of the program, garnering community support and building an effective team of volunteers not only for the festival day but also for the planning and organizing of the festival.

Educational Model

The Water Festival itself is based around four core lessons, and teachers address these four topics before and after the Water Festival in the classroom.

- **Watersheds.** Students learn what a watershed is and that they all live in one. They discover the importance of careful use of land in maintaining good water quality and begin to understand how water flows over land.
- **Water Cycle.** This activity seeks to expand students' understanding of the water cycle by showing that it is much larger than the simple evaporation-precipitation-condensation circle that students often learn in elementary school. Students become drops of water on their own personal water cycle journey to expand their knowledge of how water moves and transforms in the earth system.
- **Water Use and Conservation.** In this activity students see that improvements in water delivery and technology have changed water use habits, causing people to use a lot more water than in the past. In the end, students model ways to change their own water consuming habits.
- **Groundwater.** Students are rarely taught about the concept of groundwater in school because most adults don't understand it well enough to teach it. At the water festival, the use of interactive models helps students visualize the movement and storage of water under the earth. Students gain an appreciation of groundwater as an important source of water in Arizona.

Evaluation

In order to effectively assess the Water Festival program, it was necessary to look at the perspectives of all stakeholders. Student learning is the ultimate goal of the program and all involved, but the many facets of the program that come together to meet that goal are varied and all worthy of close examination. The evaluation utilized five different instruments in order to gather information from a variety of perspectives: teacher surveys, volunteer surveys, student questionnaires (pre-and post-festival) and structured observation forms for both students and volunteer presenters. Each component helps to develop a complete picture of the AWF programs successes and impacts.

In embarking upon a summative evaluation of the water festival program, evidence of student learning and intention to be better water stewards were paramount. However, other important questions included the effectiveness of volunteer presenters, teacher engagement and enthusiasm for the program, and organization of the setup and running of the festival itself. Table 2 lists the primary evaluation questions, the tools used to collect data to answer those questions, and the evidence expected to answer each question. Table 2 on the following page shows the various questions and sources of data.

Teachers

Teachers' opinions of the AWF program were extremely positive. They felt that the field trip was excellent in quality, that their students learned and enjoyed the water festival, and that the experience encouraged conservation habits in their students. Anecdotally, teachers said that the large event quality of the AWF, in which students see that teachers, other adults in the community, and other fourth graders were making water a priority, increased the impact of the festival. Teachers felt that the Water Festival was more effective than teaching the same concepts in their classroom, that it prepared their students well in many content areas, instructed students in topics they are required to teach and engaged students in age-appropriate activities. Furthermore, they believed that their students were more aware of the need to conserve water and more likely to do so after the festival.

From the teacher surveys, we know that teachers valued both the festival as a quality educational event, and the professional development opportunities. Further, the professional development for teachers had an impact on student learning. Based on pre- and post-student questionnaires, **students who were in the class of a teacher who attended an Arizona Project WET workshop showed greater gains in knowledge, more enthusiasm for learning about water, and could list more ways to save water than students who were in the class of a teacher who had not attended the workshop.** Teachers say things like "I will use water as the integrating context in my curriculum next year!" when describing how the workshop impacted their teaching.

Volunteers

Volunteers agreed that the water festival was a positive experience for them and for students. They were excited about the experience they had at the festival, and also eager to return in subsequent years to participate in the event. One success of the AWF is that volunteers have become the backbone of the program, and are able to make genuinely significant contributions to the festival. Because they were

Table 2: Evaluation Questions and Instruments Used

Evaluation Questions	Assessment Tools	Expected Performance Indicators
Students		
Does student knowledge of water topics improve?	Student pre- and post-questionnaires	Student scores will improve, drawings will increase in complexity and accuracy
Do students intend to become better water stewards after the water festival experience?	Student pre- and post-questionnaires	Students will express a greater desire to save water, and be able to name more ways to conserve water.
Are students actively engaged in learning while at the AWF?	Structured observation forms	Observers will find that the majority of the students are engaged the majority of the time
Teachers		
Do teachers find the water festival experience to be worthwhile and beneficial for themselves and their students?	Teacher surveys	70% of teachers agree
How does teacher professional development impact student learning?	Student pre/post questionnaires and teacher data	A comparison of student scores whose teachers attended the training versus student scores whose teachers did not attend.
Volunteers		
Do volunteers find the water festival experience to be worthwhile and beneficial for themselves and students?	Volunteer surveys, other feedback	70% of volunteers agree
Do volunteers present material as it is intended?	Structured observation forms	Observers will find that presenters follow each step of the lesson and cover the big ideas of the lesson 80% of the time
Overall		
Is each Water Festival well-organized and well-run?	Volunteer and teacher surveys, structured observation forms	70% of teachers and volunteers agree, observers agree

carefully trained to deliver lessons, they felt that they were a part of a water education movement. Likewise, students also saw that volunteers were important and they treated them as experts.

One way of assessing volunteer effectiveness is through observation. We asked four observers to watch volunteers at work at one Water Festival and to rate volunteers on a variety of criteria. **In their observations, our observers rated volunteers overall as good to very good, and found that they were most consistent with "fostering a climate of respect for students' ideas, questions, and contributions," and "making appropriate connections to other areas of science, to other disciplines, and/or to real-world contexts."** By rating volunteer presenters on a variety of effective teaching skills using a Likert scale and observing presenters facilitating all festival lessons, observers were able to paint a picture of the overall level of presentation at the Water Festival.

Table 3: Summary of Structured Observation of Volunteers

Criteria: Observers were asked to rate presenters on the following criteria and given the scale 1= not at all, 2= occasionally, 3=about half the time, 4=usually, 5= consistently	**Mode (n=15)**	**Median (n=15)**
Asked questions based on students' prior knowledge.	**4**	**3**
Asked questions that were likely to enhance the development of student conceptual understanding/problem solving (e.g., emphasized higher order questions, appropriately used "wait time," identified prior conceptions and misconceptions).	**3**	**3**
Encouraged and valued active participation of all students.	**5**	**5**
Fostered a climate of respect for students' ideas, questions, and contributions.	**5**	**5**
Made appropriate connections to other areas of science, to other disciplines, and/or to real-world contexts.	**3**	**3**
Stressed the big ideas of the lesson.	**2**	**3**
Provided adequate time and structure for wrap-up, stressing the big ideas.	**3**	**3**
Overall effectiveness of volunteer presenters. (Scale: 1=poor, 2=ok, 3=good, 4=very good, 5=excellent.)	**3**	**3**

Note: The mode and median were used because the data is skewed; not a normal distribution.

In this particular water festival, it was evident that presenters were most able to foster an environment where students were engaged in learning, but not as able to present the content of the lessons in a way

that was accessible to students. This Water Festival was somewhat atypical in that the vast majority of presenters were high school students. These students were excellent presenters in terms of their ability to relate to the fourth grade students and show enthusiasm for their chosen topic, but they struggled with the content of the lessons. Despite their struggles, high school student presenters added value to the Water Festival both in acting as role models for the younger students and in learning themselves. Our evaluation points to a need for more training with younger presenters so that they learn the content as well as the presentation skills necessary to accomplish the task.

One advantage to the model that the Water Festival uses is that in using volunteers from the host community, we are sure to work with presenters with similar cultural background and contexts as the students, thereby enriching the educational experience (Dee, 2004).

Student Learning

In order to assess student learning at the Water Festival and throughout the Water Festival unit, we used a variety of measures and instruments. Teachers and volunteers were asked to assess student learning based on their own observations, observers were asked to monitor student engagement and apparent familiarity with the content, and students themselves were tested on water knowledge as well as asked about their perceptions of the importance of water conservation and their enthusiasm for learning about water. This multi-method approach presented a varied picture of student learning that ensured accurate interpretations of the project impact.

Students enjoyed the water festival tremendously, and teachers and volunteers believe that they learn something. However, the most valuable measure of student learning is actual student demonstration of knowledge. This year, 1474 students participated in the evaluation by contributing either a pre- or a post-questionnaire, but only 1121 students completed both questionnaires (pre and post). Those who did not have complete sets were eliminated from the sample. The completed questionnaire sets, accounting for 21% of students who participated in the AWF program, constitute a significant record of student learning. The sample was broad and deep; including both students from all over the state and whole class sets of data. Use of a variety of questioning styles allowed for students to demonstrate their knowledge in whatever way worked best for them. Table 4 shows the number of students from each water festival whose scores were included in the pre post evaluation.

Table 4: Students Participating in Assessment

City	Students
Verde Valley	149
Fountain Hills	566
Payson	52
Sierra Vista	506
Tucson	28
Yuma	172
Total	**1474**

Before students attended the Water Festival, teachers were asked to administer the pre-festival questionnaire. They were asked to tell students that the questionnaire was NOT a graded test, but rather an assessment of what they knew and what they may not have known. Students were asked to complete the same assessment after participating in the program.

Once the questionnaires were returned to Arizona Project WET staff, the objective portions of them were scored. Three scores were obtained. The knowledge score measured students understanding of the water concepts covered in the Arizona Water Festival. The

conservation score measured the number of ways to conserve water that students were able to generate (out of four they were asked to generate) and the enthusiasm score measured the enthusiasm students expressed for saving water and for learning more about water. Approximately 10 percent of students' drawings were scanned into qualitative analysis software and scored as well.

Quantitative Results. Students showed an increase in all three of their scores, with the increase in the knowledge score being the greatest. The objective portions of the assessment tool, we have labeled as "water literacy". It includes knowledge of key vocabulary, understanding of processes in the water cycle, watersheds, and sources of water in Arizona. It makes sense that students would show the greatest improvement in this area, because the bulk of the content in the Water Festival program was focused on developing understanding of water systems. Likewise, a portion of the program is focused on developing the water conservation behaviors, and students who already had some knowledge of and skills in conserving water demonstrated a significant, but smaller, improvement in that area. Student enthusiasm for water conservation and learning about water increased during the program as well, which is impressive considering that students spent a significant amount of class time learning about water, **the scores showed that students had a desire to learn even more.** This is a testament to the engaging nature of the program, which gives students a positive feeling about learning in general, and learning about water in particular.

Table 5: Student Scores for Pre- and Post-Questionnaires

Sample	Mean	N	Std. Deviation	P-value
Pre-Test Knowledge	3.84	1156	1.601	
Post-Test Knowledge	5.02	1156	1.699	<0.0001*
Pre-Test Conservation	2.45	1121	1.348	
Post-Test Conservation	3.04	1121	1.139	<0.0001*
Pre-Test Enthusiasm	8.82	1155	3.427	
Post-Test Enthusiasm	9.52	1155	2.654	<0.0001*

Very small P-values show that student scores are highly correlated with program participation. Student Scores in knowledge represent a basic understanding of water concepts, conservation represents the number of ways students can name to conserve water, and enthusiasm shows their interest in learning about and conserving water.

Further, we learned that students in the classes of teachers who participated in the professional development workshop demonstrated greater gains than those who did not. Teachers who participated in the workshop were more likely to complete the full unit, and also much more likely to show their own enthusiasm for water education to students.

Once they participated in an Arizona Project WET workshop, teachers were more able to integrate water education into their whole curriculum, making the Water Festival unit not just about science but relevant to the whole academic life of the classroom. When students saw that water is connected to every aspect of life, they learned more about it and demonstrated a deeper understanding.

Table 6: Comparison of Student Scores by Teacher Workshop Participation

Sample	**Mean score** Teachers that participated in workshop	**Mean score** Teachers that did not participate in workshop	**P-value of difference**
Pre-test Knowledge	3.7670	3.8770	
Post-test Knowledge	**5.1298**	**4.9160**	0.0039*
Pre-test Conservation	2.3710	2.5070	
Post-test Conservation	**3.1700**	**2.9400**	<0.0001***
Pre-test Enthusiasm	8.5220	9.0780	
Post-test Enthusiasm	**9.6710**	**9.4010**	0.0001**

There is a statistically significant difference between the mean score gains for knowledge, conservation, and enthusiasm of students whose teachers did take the workshop to learn pre- and post-festival lessons compared to those who did not.

Qualitative Results. The drawing portion of the assessment asked students to draw to pictures, one of "the journey of one drop of water as it moves through the earth system" and another of what they knew about groundwater. The drawing portion of the test gave students an opportunity to show what they knew regardless of reading or language ability. Each drawing was scored using a rubric, which gave credit for each element included in each drawing. The scores were then compared using a repeated measures t-test statistic. The results did not show a statistically significant improvement. Ehrlen (2009) found that in asking students to draw to show their knowledge, students did not always succeed, because they lacked the ability to represent what they knew visually or their drawings were tied to culturally acceptable visual representations that did not necessarily reflect their own understandings. We also struggled with crafting questions that were specific enough to generate the rich responses we desired while still open-ended enough that we were not telling the children what to draw directly.

While not all students showed improvement in the drawing portion of the test, 48% of students showed some improvement in the drawing of the water cycle and 49% showed some improvement in the groundwater drawing. In instances where there was improvement, the drawings showed an increased complexity in understanding of the concepts. Students moved from seeing the water cycle as a linear

process of evaporation followed by condensation followed by precipitation to a process in which water moves throughout the earth system through a wider range of processes. Likewise, with groundwater, students moved from thinking of groundwater as a large lake under the ground with no connection to the greater water system to understanding that it was an important source of water for human use in Arizona and connected to the larger water cycle through both manmade and natural connections. Figures 1-4 on the following pages depict student drawings that were representative of the shifts evident in student thinking about groundwater and the water cycle.

Conclusion: Impacts and Lessons Learned

The Arizona Water Festival Program demonstrates significant impact on our communities through volunteers, teachers, and students. Water festival communities are growing young water stewards while at the same time uniting their communities around critical resource issues. This summative evaluation demonstrates the impact of Water Festivals on student learning and on teachers, volunteers, and communities. It generates suggestions, not only for the Water Festival Program specifically, but also for communities interested in developing awareness and education about water issues.

Impacts

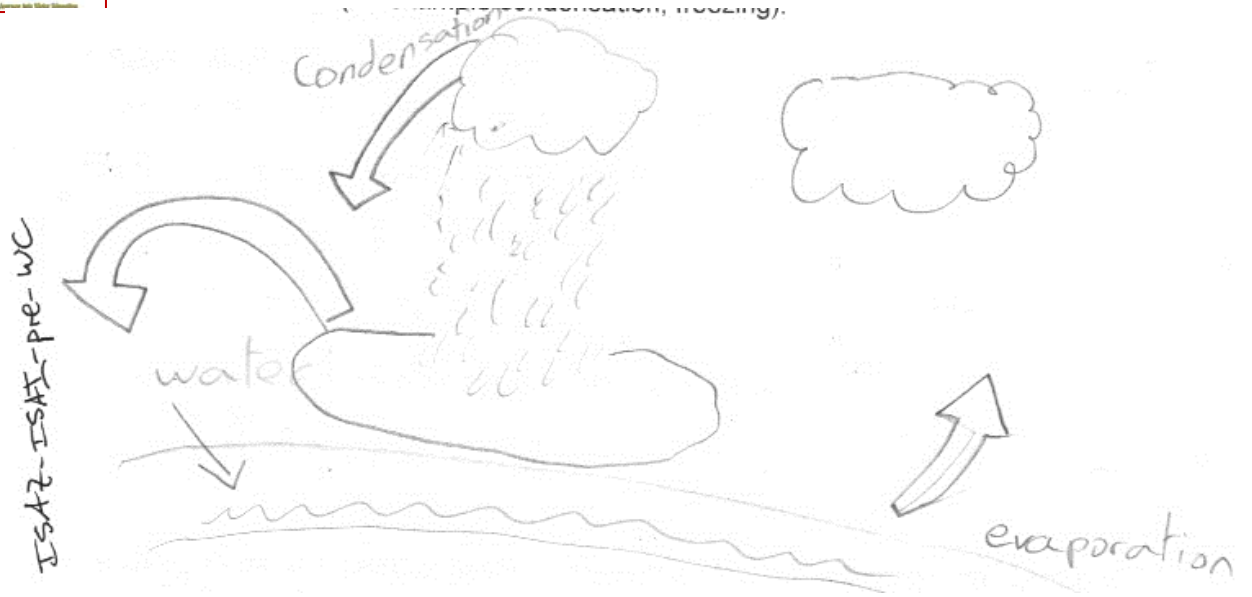
The Arizona Water Festival program has in this one year of its nine year history reached nearly 7,000 students. This represents a significant portion of Arizona's fourth graders, and to date the Water Festival program has served 33,337 young Arizonans in 20 Arizona communities. This means that we have a corps of young students who have spread the messages of care for watersheds, conservation of a precious resource, and the wonder of awe-inspiring water to their friends and families. When people know where their water comes from, and how all things are interrelated through water, they are more likely to make good water use and management decisions in the future.

We have also trained hundreds of volunteers to deliver effective water education. This transcends the water festival, as members in the community are now more able to talk about water issues with their friends and colleagues and throughout the community and have increased their own water literacy as a result of participating in the program.

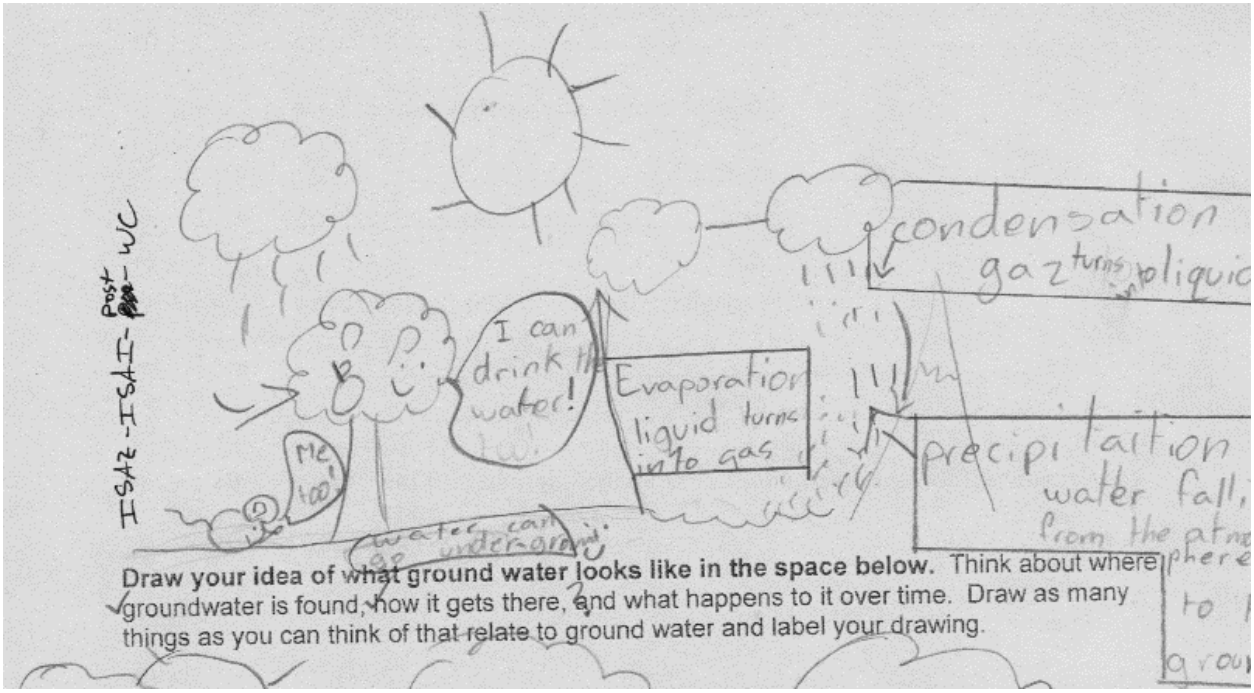
Further, 1,336 teachers have worked with their students to enhance the learning experience of the Water Festival by carrying the learning goals into the classroom. This creates a learning community where teachers and students alike are motivated to learn about water and to work together to protect Arizona's water future. Our assessment shows that not only do students know more about water after the water festival; they are more interested in learning about water, and feel that water conservation is more important after the Water Festival.

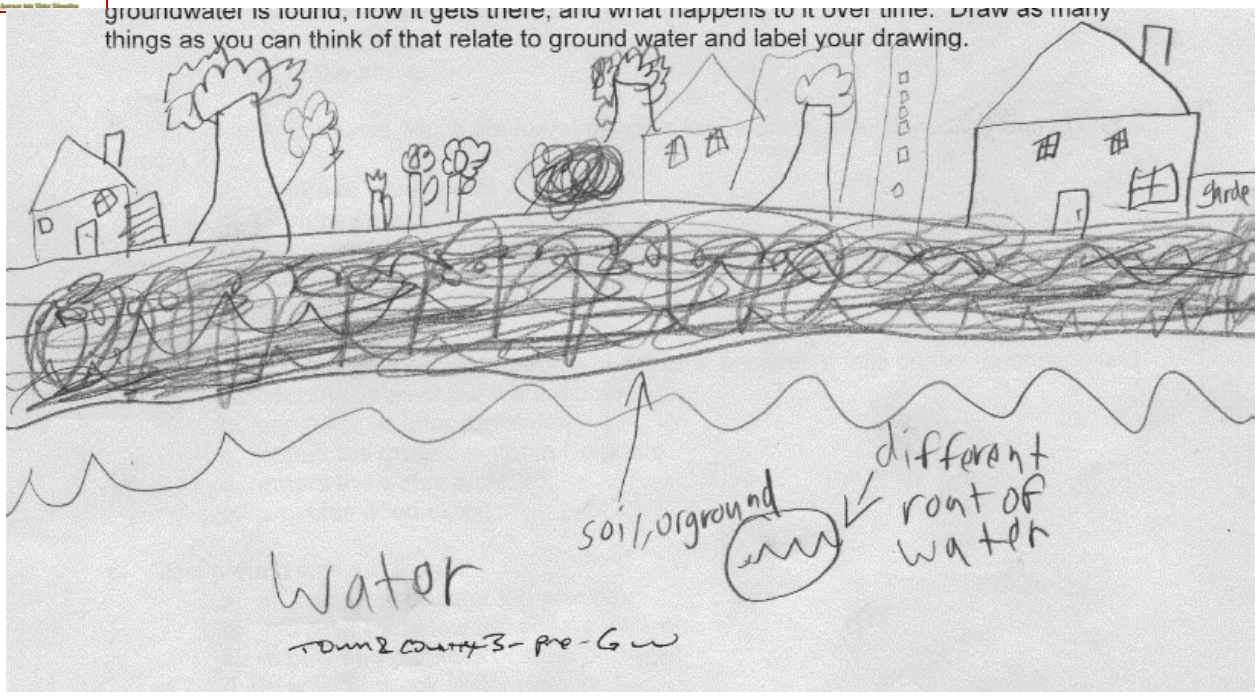
Lessons Learned

One key finding of this assessment effort is that the professional development for teachers is an essential component of the program in terms of student learning. This gives Arizona Project WET solid

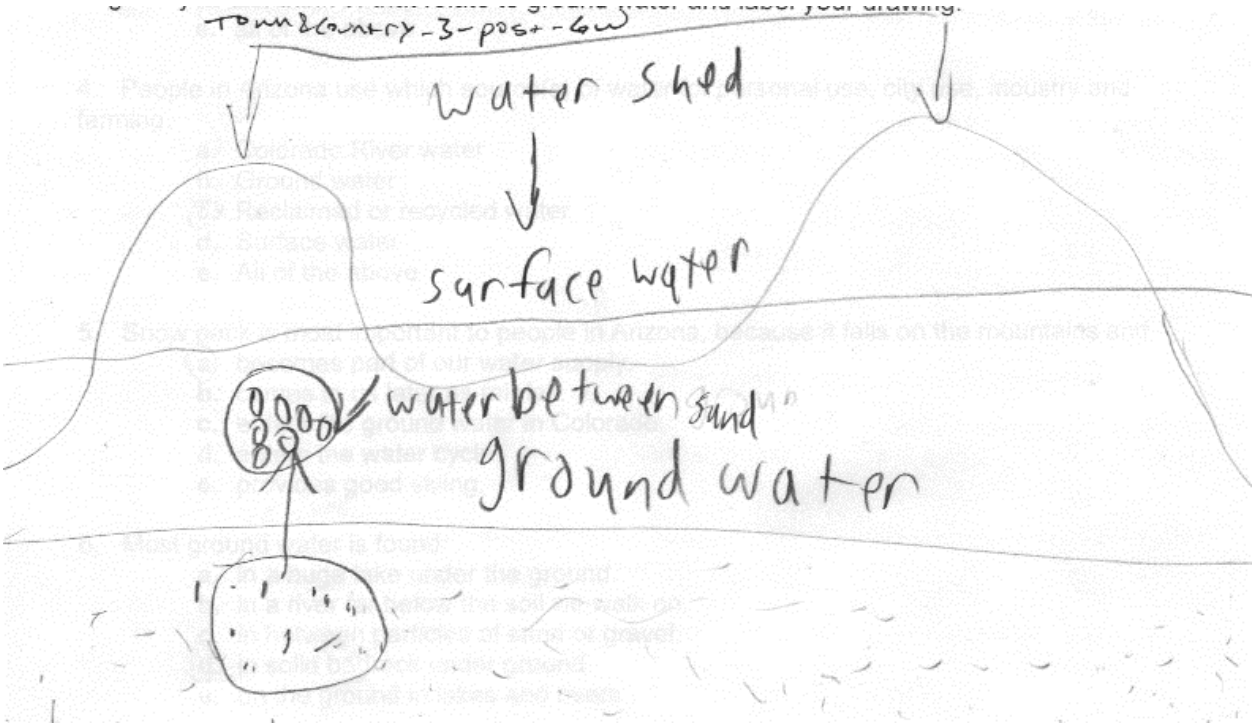


Figures 1 & 2: One student's drawing of the water cycle before the Water Festival (above) and after the Water Festival (below). The first drawing is accurate, but the second drawing shows an increase in the complexity of the student's understanding of how water moves through the Earth system.





Figures 3 & 4: Before the water festival (above) students only recognize groundwater as water under the ground, typically in a large lake or underground cave. After the water festival (below) students understand the groundwater/surface water connection and see that groundwater is between the grains of sand and gravel.



grounding from which to continue our efforts in this arena and evidence to show that our professional development is effective. For the Water Festival program in particular, it emphasizes the need to communicate to teachers that this is not just a "wonderful field trip," but part of a whole learning unit that can significantly increase test scores and help their students learn Arizona State Science Standards.

Arizona Project WET is very proud of our trained volunteers and their ability to deliver educational material in an effective, hands-on, dynamic way. Findings from this assessment emphasize the need for the content knowledge of the presenters to be deepened before the Water Festival so that presenters provide students with a rich, engaging learning experience that emphasizes the key points of the lesson and allows students to reach complex understandings of new topics.

We were surprised to find that many students were unable to draw their understandings of groundwater and the water cycle. While this is in accordance with the existing body of literature, it is important to note that it is difficult to move students, for example, beyond their original understanding of a rather static, un-complex water cycle to a more rich system in which water moves through plants and animals. This suggests that instructional practices that build foundational knowledge and follow a constructivist approach may be needed for true conceptual understanding to occur. We will explore ways of improving student learning and their ability to express their new understandings of the water cycle and groundwater system.

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cals.arizona.edu/pubs/water/az1546.pdf

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