Concord Evaluation Group

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Plum Landing: Family and Afterschool Evaluation Report

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Contact

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Executive Summary

Project Overview

Plum Landing (http://pbschildren.org/plumlanding/) is produced by WGBH Educational Foundation (http://wgbh.org), the Public Broadcasting Service affiliate based in Boston, MA. The website, Plum Landing, follows the adventures of an animated space alien, named Plum, after her spaceship crash-lands on Earth. With funding from the National Science Foundation, the Corporation for Public Broadcasting, The Kendeda Fund, and the Northern Research Station, Forest Service, U.S. Department of Agriculture. WGBH worked closely with a panel of science advisors to create an "innovative, environmental science curriculum for 6-9 year olds." Plum Landing is aligned with the Next Generation Science Standards and is designed to give children an understanding of the science underlying healthy ecosystems and sustainability.

Plum Landing includes more than 60 animated stories and live action videos and games based on Plum's various destinations on Earth. The website also includes a drawing tool called the Nature Sketchpad that enables players to tackle a mission that features a particular plant or animal. Nature Sketchpad allows players to create images to save or "share" with Plum. Plum Landing also includes a free iPhone app, Plum's Photo Hunt, that encourages children to head outside to tackle "missions" by photographing nature. Photos may be saved (to the device) or sent to Plum for review and possible posting in the online galleries or on social media.

The Plum Landing digital curriculum offers resources for educators to extend the learning into a variety of settings: afterschool programs (such as Girls Inc., Girl Scouts USA, YMCAs, Boys & Girls Clubs); summer camps; and programs coordinated by museums and local public television stations. The curriculum's pathways provide a collection of hands-on science activities and media resources—animations, videos, games, a photo app and more—arranged in a thematic sequence and aligned to the Next Generation Science Standards.

Plum Landing also includes activities for parents that may be used outside with their children to explore the world together.

Evaluation Overview

Concord Evaluation Group (CEG) conducted an evaluation of Plum Landing in fall of 2014. The study included two components: (1) a national, home-based experiment that included 52 families in a treatment group (using Plum Landing resources) and 52 families in a control group (not using Plum Landing resources), and (2) an afterschool-based, randomized block design study that included 126 children across four treatment group sites (using Plum Landing resources) and four control group sites (not using Plum Landing resources). Both studies incorporated pre-test and post-test surveys. Below we summarize the main findings.

Topline Findings

Plum Landing had a significant impact on parents' environmental science-related interests, attitudes, and confidence. Specifically, parents who used Plum Landing resources were more likely than parents who did not use Plum Landing resources to report that they were interested in exploring nature with their child(ren) (p = .019), that they enjoyed exploring nature with their child(ren) (p = .039), that they think it's important to support their child(ren)'s interest in nature, and that they were more comfortable exploring nature with their child(ren) (p = .054). Parents in the treatment group showed significant improvement in their beliefs that it was important to support their children's interest in nature, likely as a result of using Plum Landing, while parents' beliefs in the control group did not change (p = .048). However, there were no observable differences between the groups with respect to the importance that parents placed on their children's explorations of nature when they played outside. All parents believed that it was important for their children to explore nature when they played outside, so there was no room for growth.

> *It made learning about nature fun and educational! My daughter was having so much fun; she didn't realize how much she was learning about nature!*
>
> *- Parent*

Plum Landing had a significant impact on children's environmental science-related habits of mind. In both studies, we found evidence that Plum Landing had an impact on the treatment group students' environmental science habits of mind. The treatment group responses indicated that students had learned to ask relevant questions based on information learned from Plum Landing. When compared with the control group, the treatment group responses were more likely to specifically pose insightful, relevant

questions that were directly connected directly to Plum Landing content. Parents of children who used Plum Landing resources were more significantly likely than parents of children who did not use Plum Landing resources to report that their children were interested in learning about nature (p = .032) and that their children asked interesting questions about how things work in nature (p = .007). Forty-six out of 52 parents (88%) agreed that Plum Landing helped their child formulate relevant questions about environmental science. In the afterschool study, four out of four of the afterschool educators reported that Plum Landing helped their students ask interesting and appropriate questions about how things work in nature.

> *Plum Landing planted a seed of interest in my child about nature and made it more understandable...this gave me direction to get out and experience with my child the beauty and wonders of nature.*
>
> *- Parent*

Plum Landing had a significant impact on children's interest in exploring nature. The family study revealed that children who used Plum Landing resources were more likely than children who did not use Plum Landing resources to report that they were interested in exploring nature (p = .015). Additionally, parents in the treatment group were more likely to report, at post-test, that their children were interested in nature than parents in the control group (p = .032). Forty-nine out of 52 parents (94%) agreed that Plum Landing helped their child become more interested in exploring nature. In the afterschool study, three out of four educators reported that Plum Landing made their students *more* interested in learning about nature and *more* motivated to learn about nature, even though most of them were interested and motivated to begin with. The fourth educator reported that her students already *were* interested and motivated to explore nature, so there was no room for change.

> *I myself learned something new each time we used the app together…. It was good to get information about all sorts of plants and animals and I sort of think of it as a mini vacation getaway.*
>
> *- Parent*

Plum Landing had a significant impact on children's environmental science content knowledge. In both studies, we found that children who used Plum Landing resources scored higher and provided responses that were more detailed and elaborate than children who did not use Plum Landing resources, even when controlling for age (p = .027 and p = .009). Consistently, the treatment group responses referred to specific content

(certain animals, plants, animal habits, professional jobs associated with the desert, etc.) that was not observed in control group responses. Treatment group responses clearly connected Plum Landing content to the question being asked.

In the family study, over time, we observed significant growth in children's understanding of how plants and animals get what they need to survive in a desert among families that used Plum Landing versus families that did not use Plum Landing (p = .010). Nearly all treatment group parents (94%) reported that their children learned about nature from Plum Landing and 96% reported that their children were able to think about how their home is different from and similar to a desert. Most children (90%) reported that they did learn something new from Plum Landing. In the afterschool study, four out of four of educators reported that Plum Landing taught their students about nature.

Children and parents who used Plum Landing resources were nearly unanimously positive about their experience. For example, 96% of parents reported that Plum Landing helped to motivate their child to go outside and explore nature. Similarly, 96% of parents reported that their child was able to think about how the place where they live is similar to and different from a desert. In addition, 94% of parents reported that Plum Landing made their child more interested in learning about nature, 94% of parents reported that their child learned about nature from Plum Landing, and 89% of parents reported that Plum Landing helped their child ask interesting and appropriate questions about how things work in nature. Children held Plum Landing in high regard as well: 95% of children in the family study reported that they "liked" or "loved" the Plum Landing website.

> *I discovered a lot of new things through this website. I liked the idea of exploring nature and I am going to take mommy with me now.*
>
> *- 8-year old boy from urban area of CA*

Educators were also unanimously positive about Plum Landing and their reflections provide a more nuanced picture. All afterschool educators who used Plum Landing in their programs reported that Plum Landing was **engaging** for them and their students. For example, one educator reported, "Plum Landing was...entertaining for both students and educators. The missions and animation were wonderful (ways) to follow and visualize the exploration." Another educator, familiar with other digital curricula, reported, "This is really a groundbreaking site."

Educators reported that they and their students enjoyed the interactivity of the digital curriculum components and that the experience **motivated** their students to do more activities like the ones they tried in the study or to learn more about the topics covered. For example, one educator reported, "(It was a) very interactive website so the students and I enjoyed clicking away and exploring all the resources." Others reported that their students were eager to try more Plum Landing pathways after the study ended. In part, students were motivated by the fact that their pictures appeared online, "They also were motivated by going online and seeing the pictures they took there." Two educators reported, "The kids saw some of the other areas that Plum visited and want to learn about those areas." and "...the students wanted more, but that gives me the chance to have them do a little research on their own." All afterschool educators reported that digital curriculum **supported their ability to teach** their students about environmental science. For example, one educator reported, "The descriptions were great and helped guide the educator into a smooth transition when having discussions." Another educator reported, "An afterschool program could easily use this regularly with their kids and have possibly enough science activities for the year."

Educators reported that one strength of the curriculum lies in the **age-appropriate science content**. One educator reported, "(The videos) are extremely age appropriate. The kids were able to remember facts from the videos shown the previous week when I asked them questions at the start of the next meeting one week later."

Educators reported that other strengths lie in the **format and accessibility** of the curriculum. Educators also found the content to be well planned out, and easy to follow. Several educators reported that "...the videos and activities were easy to follow and short." Others reported, "It was also nice to have the activities and questions all laid out for me." and "It was very easy to navigate through."

All of the educators also appreciated that the materials required for the hands-on activities were "**inexpensive supplies** that most sites readily have access to." For example, one educator reported, "I liked that the materials for the most part were very simple and we already had most of them at our program."

Plum Landing did not have an impact on afterschool educator's comfort levels leading environmental science-related activities with their students nor did it impact their interest in exploring nature with their students. Plum Landing did not impact educators' comfort levels exploring nature with their students because they had high comfort levels at the outset

of study. Plum Landing did not impact educators' interest in exploring nature with their students, again, because all of the educators reported having high levels of interest at the outset of the study. *For future evaluation studies, we recommend purposely recruiting educators who report that they are* not *comfortable and* not *interested in exploring environmental science with their students, so there is a potential to assess whether Plum Landing can change educators' comfort and interest levels.*

Background

Project Overview

Plum Landing (http://pbschildren.org/plumlanding/) is produced by WGBH Educational Foundation (http://wgbh.org), the Public Broadcasting Service affiliate based in Boston, MA. On the website, Plum describes herself as "…just your run-of-the-mill space traveler from the Planet Blorb. My home is a pretty bleak place so I, and my fellow Blorbians, stare up into the night sky and dream of Earth. You have so much here that's beautiful and special, though sometimes I think you Earthlings don't notice it."

The website, Plum Landing, follows the adventures of Plum after her spaceship crash-lands on Earth and she interacts with her new Earthling friends. As Plum describes the website, "Plum Landing is my exciting multi-platform, indoor-outdoor, science exploration adventure for children and grown-ups. We've got games, animations, videos, an app, a whole digital curriculum for afterschool programs and summer camps, and science activities for parents and children to do together. This will get everyone discovering what we Blorbians have known for a long time: that you live on an incredible planet."

With funding from the National Science Foundation, the Corporation for Public Broadcasting, The Kendeda Fund, and the Northern Research Station, Forest Service, U.S. Department of Agriculture. WGBH worked closely with a panel of science advisors to create an "innovative, environmental science curriculum for 6-9 year olds." Plum Landing is aligned with the Next Generation Science Standards and is designed to give children an understanding of the science underlying healthy ecosystems and sustainability.

Plum Landing includes more than 60 animated stories and live action videos. The animated stories chart the adventures of Plum's new friends, Brad, Clem, Oliver, Gabi and Cooper, as well as show Blorbians what's wonderful about planet Earth. The live action videos show real children going out into the world and exploring as Plum's friends do in the animated stories.

The website also includes games based on the four locations Plum and her friends are visiting (e.g., the deserts of Australia, the mangroves of Belize, the Rocky Mountains in Canada and the jungles of Borneo). For each destination, children can play these exploratory games while photographing different kinds of plants and animals, and experimenting with a digital simulation, where they can

place the different inhabitants in their habitats and keep everything as healthy as possible for 12 days. The goal of these games is for players to learn about food webs, habitats and adaptations. In every game, players can login and save their points and use their points to "buy" stickers of plants and animals. The stickers are akin to living safari cards containing information about each featured animal.

Figure 1. The "Trash Detective" submitted to Plum website.

The website includes a drawing tool called the Nature Sketchpad that enables players to tackle a mission that features a particular plant or animal (see figure left). Nature Sketchpad allows players to create images to save or "share" with Plum. A simple form lets children write about their pictures and upload them for staff at WGBH to review. After WGBH staff reviews them, drawings may be posted in one of Plum's many mission galleries online on Plum's Tumblr blog or on Plum's Facebook page.

Plum Landing also includes a free iPhone app, Plum's Photo Hunt, that encourages children to head outside to tackle "missions" by photographing nature. Photos may be saved (to the device) or sent to Plum (WGBH staff) for review and possible posting in the online galleries or on social media (see figure right).[1]

Figure 2. "Animal Life" submitted to Plum website.

The Plum Landing digital curriculum offers resources for educators to extend the learning into a variety of settings: afterschool programs (such as Girls Inc., Girl Scouts USA, YMCAs, Boys & Girls Clubs); summer camps; and programs coordinated by museums and local public television stations. The curriculum's pathways provide a collection of hands-on science activities and media resources—animations, videos, games, a photo app and more—arranged in a thematic sequence and aligned to the Next Generation Science Standards.

Plum Landing also includes activities for parents that may be used outside with their children to explore the world together.

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[1] WGBH staff review every submission to ensure that they do not contain images of children and that they are appropriate for posting online.

Evaluation Overview

WGBH hired Concord Evaluation Group (CEG) to conduct an evaluation of the Plum digital curriculum for parents and afterschool educators to determine the extent to which the Plum Landing project was able to achieve its intended impacts. The evaluation included two separate, but related studies, to explore the impact of Plum Landing: (1) A family study, and (2) an afterschool program study. This report describes the findings from both of these studies.

Family Study

Study Design

Objectives

In the fall of 2014, CEG designed and carried out a study to evaluate the impact of Plum Landing on families. The project's intended impacts on families are listed below:

Impact 1: Children's **environmental habits of mind** (i.e., questions you need to ask when investigating an ecosystem) will be enhanced as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

Impact 2: Children's **enthusiasm for and interest in the environment** will increase as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

Impact 3: Children will **learn environmental science content** as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

Impact 4: Children will be more **motivated to learn about their environment** as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

Impact 5: Parents will be more **interested in exploring environmental science with their children** as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

Impact 6: Parents will be more **comfortable exploring environmental science with their children** as a result of visiting the Plum Landing site and interacting with the Plum Landing resources

Recruitment

CEG conducted a home-based experiment with families from across the United States. We recruited families by contacting parents who have previously participated in, or indicated an interest in participating in, a study with CEG. We contacted parents and summarized the study. Parents interested in participating in the study completed a recruitment screener form online to determine their eligibility. Families were eligible to participate if they met the following criteria:

- Families must include at least one child aged 7-9 years,
- Families must have at least occasional access to the Internet, and
- Families must have access to a mobile device with a built-in camera or a digital camera.

Participants

A total of 104 families participated in the family study; 52 families in the treatment group and 52 families in the control group. The table below summarizes the families' demographic characteristics. There were slightly more boys than girls in both groups (52% of the treatment group and 54% of the control group). The average age of children in both groups was eight.

White children comprised the majority in both groups, with significantly more white children in the control group (85%) than in the treatment group (62%). There were no statistically significant differences between the two groups of parents with respect to race/ethnicity. Most of the parents who participated in the study were mothers versus fathers (69% of the control group and 73% of the treatment group). Finally, most of the families in both groups hailed from suburban settings (62% of the control group and 52% of the treatment group). While more families in the treatment group lived in urban settings (37%) than families in the control group (17%), these differences were not statistically significant.

Table 2:
Participant Characteristics

Participant Characteristics	Treatment Group Count and Percent (n = 52)	Control Group Count and Percent (n = 52)
Child's Gender		
Female	25 (48.1%)	24 (46.2%)
Male	27 (51.9%)	28 (53.8%)
Child's Age		
Seven	21 (40.4%)	14 (26.9%)
Eight	17 (32.7%)	16 (30.8%)
Nine	14 (26.9%)	22 (42.3%)
Child's Race / Ethnicity		
White or Caucasian*	32 (61.5%)	44 (84.6%)
Hispanic, Spanish or Latino/a	12 (23.1%)	7 (13.5%)
Black or African-American	11 (21.2%)	6 (11.5%)
Asian	4 (7.7%)	2 (3.8%)
Native American or Alaskan Native	0 (0.0%)	1 (1.9%)

Participant Characteristics	Treatment Group Count and Percent (n = 52)	Control Group Count and Percent (n = 52)
Native Hawaiian or Other Pacific Islander	2 (3.8%)	1 (1.9%)
Parent's Relationship to Child		
Mother	38 (73.1%)	36 (69.2%)
Father	12 (23.1%)	13 (25.0%)
Parent's Race / Ethnicity		
White or Caucasian	36 (69.2%)	40 (76.9%)
Hispanic, Spanish or Latino/a	9 (17.3%)	5 (9.6%)
Black or African-American	9 (17.3%)	6 (11.5%)
Asian	4 (7.7%)	2 (3.8%)
Native American or Alaskan Native	0 (0.0%)	1 (1.9%)
Native Hawaiian or Other Pacific Islander	2 (3.8%)	1 (1.9%)
Setting		
Urban	19 (36.5%)	9 (17.3%)
Suburban	27 (51.9%)	32 (61.5%)
Rural	6 (11.5%)	11 (21.2%)

* There was a statistically significant difference between the two groups (Chi-square $_{(df=1)}$ = 5.914, p = .015).

Methods and Procedures

Eligible families were randomly assigned to either a treatment group or a control group. Families in both groups completed a pre-test survey at the start of the study. After completing the pre-test survey, members of the treatment group were provided with access to the Plum Landing website and its resources, while the control group was not instructed to do anything out of the ordinary.

Treatment Group Procedures

Study Instructions

Treatment group families were instructed to get introduced to Plum by watching a one-minute animation with their children: http://pbskids.org/plumlanding/video/more.html?guid=3587702a-3df6-4950-b09c-62240a2f5375

We encouraged them to watch as many other animations as they liked. Next, we asked families to visit the Plum Landing website at http://pbskids.org/plumlanding/parents/

We instructed them to take their time exploring the website with their children. We required all families in the treatment group to view/use the following resources that focused on desert ecosystems and water:

Animations/Cartoons (Each cartoon was between 1 and 5 minutes)

- The Lost Lake:
  http://pbskids.org/plumlanding/educators/context/101_the_lost_lake.html
- The Search for Shrimp:
  http://pbskids.org/plumlanding/educators/context/102_the_search_for_shrimp.html
- Digging for Clues:
  http://pbskids.org/plumlanding/educators/context/103_digging_for_clues.html
- Earth to Blorb: The Desert!:
  http://pbskids.org/plumlanding/educators/context/113_earth_to_blorb_the_desert.html
- Deserts Aren't Dead:
  http://pbskids.org/plumlanding/educators/context/117_deserts_arent_dead.html
- Brad Befriends a Bilby:
  http://pbskids.org/plumlanding/educators/context/126_brad_befriends_bilby.html

Games

- Explore the Outback:
  http://pbskids.org/plumlanding/educators/context/explore_the_outback.html
- Feed the Dingo:
  http://pbskids.org/plumlanding/educators/context/feed_the_dingo.html

Live Action Videos (Each of these videos with real families was less than 5 minutes)

- Build a Rain Barrel:
  http://pbskids.org/plumlanding/educators/context/131_build_a_rain_barrel.html
- Visit a Vernal Pool:
  http://pbskids.org/plumlanding/educators/context/132_visit_a_vernal_pool.html
- Race to Save Water:
  http://pbskids.org/plumlanding/educators/context/133_race_to_save_water.html

In addition to the web-based resources listed above, families were expected to engage in two outdoor, hands-on activities together. We informed families that we expected each activity to take about an hour to complete and that the activities would require some everyday household materials.

- Evaporation Station: http://pbskids.org/plumlanding/educators/activities/evaporation_station_fam.html
- Roots and Shoots: http://pbskids.org/plumlanding/educators/activities/roots_and_shoots_fam.html

We also pointed families to a handout that contained tips on ways parents could get their children outside (http://pbskids.org/plumlanding/parents/tips.html).

Photo App

For families with access to an iPhone or an iPod Touch, we told them about Plum's Photo Hunt App: http://pbskids.org/apps/plums-photo-hunt.html.

The app was free and the pictures sent by families to Plum could appear on the website, after review by WGBH staff. Pictures containing personal identifiable information, including pictures of people, were never published to the website. Families without access to an iPhone or iPod Touch were encouraged to send photos directly to the evaluator via email.

Treatment Group Fidelity

Fidelity refers to the extent to which treatment group participants actually engaged in the required study activities. The table below summarizes the number of treatment group families that actually completed the various activities, videos, and games. *We found that the majority of families were able to complete all or most of the required activities for the study.*

Specifically, with respect to the animations, 34 families (65%) watched all six of the required videos. Eight families (15%) watched three or four of the six videos. Another eight families (15%) watched only two or three videos. Two families watched only a single video. With respect to the two required games, 41 families (79%) played both games, while 11 families (21%) played only one game.

With respect to the live action videos, 39 families (75%) watched all three required videos, while nine families (17%) watched two of the three videos. Four families (8%) watched only a single live action video. With respect to the outdoor

activities, 34 families (65%) tried both required activities, while 17 families (33%) tried one of the two activities. One family was not able to do either of the outdoor activities.

Half (50%) of the treatment group was unable to use the Plum Photo App because they did not own a compatible device (the app is currently only compatible with Apple™ devices). Most of these families (20 out of 26) took photos during the activities with their own cameras and emailed them to the evaluation team. The other half of the sample (26 families) were able to take photos with the app—with 17% reporting that they took five or more photos using the app. Most of the families taking photos with the app (n = 21, 81%) were successful in uploading the photos to the Plum Landing website.

Table 1:
Activities Families Completed During the Study

Activity	Count and Percent (n = 52)
Animations	
The Lost Lake, Desert 1	47 (90.4%)
The Search for Shrimp, Desert 2	47 (90.4%)
Digging for Clues, Desert 3	46 (88.5%)
Earth to Blorb: The Desert!	45 (86.5%)
Deserts Aren't Dead (Desert Song)	41 (78.8%)
Brad Befriends a Bilby	39 (75.0%)
Games	
Feed the Dingo	47 (90.4%)
Explore the Outback	45 (86.5%)
Live Action Videos	
Build a Rain Barrel	49 (94.2%)
Visit a Vernal Pool	47 (90.4%)
Race to Save Water	43 (82.7%)
Outdoor Activities	
Evaporation Station	43 (82.7%)
Roots and Shoots	42 (80.8%)
Plum's Photo App	
Took photos using camera without the app	20 (38.5%)
Took 3-5 photos with the app	10 (19.2%)
Took 5 or more photos with the app	9 (17.3%)
Took 1-2 photos with the app	7 (13.5%)
Took no photos with the app	6 (11.5%)
Emailed photos rather than uploading	27 (51.9%)
Uploaded 1-2 photos with the app	7 (13.5%)
Uploaded 3-5 photos with the app	7 (13.5%)
Uploaded 5 or more photos with the app	7 (13.5%)

Activity	Count and Percent (n = 52)
Uploaded no photos with the app	4 (7.7%)

Post-test Procedures

At the end of two weeks, families in both groups completed a post-test survey. All surveys were completed online. Given the young age of the children in the study, we expected that some would not be capable of responding to an online survey without assistance. So, we trained parents how to type for their children (if needed) without adding their own input. We pilot tested the surveys and this methodology to ensure that parents would not interfere with their children's answers and that children's responses were solely their own.

Findings

Below, we have presented the findings summarized by the project's intended impacts.

Impact 1: Children's environmental habits of mind (i.e., questions you need to ask when investigating an ecosystem) will be enhanced as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

Finding: Plum Landing enhanced children's environmental habits of mind.

To assess the impact of Plum on children's environmental habits of mind, we asked children: *If you could learn more about deserts, what else would you like to know?* We analyzed their responses to look for evidence that children could formulate appropriate questions to ask when investigating an ecosystem, and whether there were any noticeable differences between the children who used Plum and the children who did not.

We found evidence that Plum Landing had an impact on the treatment group students' environmental science habits of mind. The treatment group responses indicated that students had learned to ask relevant questions based on information learned from Plum Landing. When compared with the control group, the treatment group responses were more likely to specifically pose insightful, relevant questions such as:

- *I want to know more about plants. Do they have any rocks and gems?*
- *Do people have jobs in the desert besides archeologists?*
- *What have scientists discovered there?*
- *What about desert lakes and also stones that look like plants?*

Responses that connected directly to Plum Landing content posed questions such as:

- *How do the different animals live, like the ones that dig deep tunnels down and lay eggs buried down?*
- *How can animals live in such heat?*
- *What is the lowest temperature that it gets in the desert?*
- *What was the need of deserts?*
- *What if all deserts vanish?*

We also asked parents to report on the extent to which their children were able to formulate interesting questions about how things work in nature. We found that **parents in the treatment group were significantly more likely to report that**

their children asked interesting questions about how things work in nature, after using Plum Landing. This result represents a statistically significant increase from pre-test to post-test for the treatment group children versus the control group children.[2]

Figure 3. Family photo from Plum activity.

To further explore whether Plum Landing was the reason for this difference, we asked treatment group parents to report how much they agreed or disagreed that Plum Landing actually was responsible for helping their children ask interesting and appropriate questions about how things work in nature. **Forty-six out of 52 parents (88%) agreed that Plum Landing helped their child formulate relevant questions about environmental science.**

Impact 2: Children's enthusiasm for and interest in the environment will increase as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

Finding: Plum Landing enhanced children's interest in exploring the environment.

We asked children in both groups to report whether they were interested in exploring nature at the start of the study and at the end of the study. Most children in both groups reported they were interested in exploring nature at the start of the study. At pre-test 61% of the control group and 77% of the treatment group was interested in exploring nature. By the end of the study, 67% of the control group reported they were interested and 85% of the treatment group children reported they were interested. **Treatment group children showed a statistically significant improvement in their interest in exploring nature, after using Plum Landing.**[3]

We also asked parents at pre-test and post-test to report the extent to which their children were interested in exploring nature. **Parents in the treatment group were more likely to report, at post-test, that their children were interested in nature than parents in the control group.**[4] This result provides further evidence that Plum Landing positively impacted children's interest in exploring nature.

To further explore whether Plum Landing was the reason for this observed difference, we asked treatment group parents to report how much they agreed or

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[2] $F_{(df = 1, 99)} = 7.529$, p = .007.
[3] $F_{(df = 1, 99)} = 6.076$, p = .015.
[4] $F_{(df = 1, 101)} = 4.718$, p = .032.

disagreed that Plum Landing actually was responsible for helping their children become interested in exploring nature. **Forty-nine out of 52 parents (94%) agreed that Plum Landing helped their child become more interested in exploring nature.**

Impact 3: Children will learn environmental science content as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

Finding: Plum Landing enhanced children's environmental science content knowledge.

To assess environmental science content knowledge, we developed a set of six questions designed to test students' knowledge about deserts–the ecosystems covered in Plum Landing that was featured in the media and activities the families used (see below for the specific questions). Children earned points for each correct, or partially correct, response. See Appendix C for a summary of the possible points available for each question.

Figure 4. "Cactus Blooming" submitted by a family.

Children's pre-test and post-test scores were calculated by summing their points across the questions. Scores on the pre-test ranged from one to 26 points, while scores on the post-test ranged from zero to 26 points. We also computed reliability statistics for both scales to ensure their internal consistency (i.e., the degree to which the questions relate to each other and, used together, constitute a single measure of knowledge). Both scales had fair Cronbach's Alpha reliability coefficients (.59 for the pre-test survey and .68 for the post-test survey).[5]

We found that treatment group children demonstrated significantly greater knowledge of environmental science content knowledge after using Plum than the control group. Treatment group children had an average knowledge score of 20.00 (standard deviation = 3.43) after using Plum while control group students had an average knowledge score of 18.26 (standard deviation = 4.37).[6]

While responses from both groups indicated at least a general understanding of desert ecologies, the treatment group responses referred to specific content (certain animals, plants, animal habits, professional

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[5] These alpha coefficients indicate that the questions *may* be measuring more than one construct (i.e., knowledge plus another factor), but we would need a much larger sample to run analyses to determine this.

[6] $F_{(df = 1, 85)}$ = 5.095, p = .027.

jobs associated with the desert, etc.) that was not observed in control group responses. Below, we highlight some of the major differences between the two groups with respect to how they responded to each of the individual questions.

Question 1: Please list three things that are special about the desert.

The difference between the two groups was not great with respect to this question. Both groups had 12 children who achieved a full score of six points. Treatment group post-test responses specifically touched on content seen in Plum. Responses like "an entire lake can come and go," "deserts aren't as dry as I thought, they actually get a lot of water," and "some are dry, some cold, all get little rain" were clear indicators of corrected misconceptions and learning that happened as a result of interacting with Plum. Additionally, other responses like "it's not dead" and "shrimp" show clear connections to Plum content.

However, some treatment group responses and most of the control group responses, still revealed misconceptions about the desert like "no water", "no food", and other answers that said there were no trees or flowers in the desert, while there were still some one word common responses like "hot" and answers that reflected misconceptions.

Question 2: Please name three animals or plants that live in the desert.

This question showed a greater difference between the groups than the previous question did. Thirty-one percent of treatment group responses received a full score of 6 on this question after using Plum, versus 18% of control group responses that earned full credit. Treatment group post-test responses referred to Plum Landing content like desert pea, shrimp, bilbies, dingos, and pelicans – responses not seen in the control group responses.

Question 3: Please list two things that desert plants need to survive.

This question also showed a significant difference between the groups. Seventy-four percent of treatment group responses received a full score of 6 on this question after using Plum, versus 57% of control group responses that earned full credit. Treatment group post-test responses discussed "adaptation" whereas none of the control group responses did.

Question 4: How do desert plants and animals get what they need to survive?

Again, this question revealed a significant difference between the groups. Fifty percent of treatment group responses received a full score of 2 on this question after using Plum, versus 33% of control group responses that earned full credit.

In both groups, at pre-test, it seemed like some students already had a basic understanding of how animals and plants survive in the desert. In both the control group and treatment group post-test, there were some similar types of responses such as killing, hunting, nature, hide, adaptation, looking around, eating, and finding. However, we observed responses in the treatment group post-test responses that we did not observe in the control group responses, such as:

- *Some of them eat at night.*
- *They move slowly the animals in the desert.*
- *The birds drink from cactuses.*
- *Some plants have a bad odor or taste to ward off potential predators.*
- *Bilbies dig holes in the ground to get shelter.*
- *Dingos go to water holes to get their food and water.*
- *Plants depend on the rain and have long roots so they can store water in their roots.*
- *It's moist at the bottom of the soil so the roots get water that way.*

Question 5: Please list one way that the desert is the SAME as the place where you live.

Again, this question revealed a significant difference between the groups. Forty-nine percent of treatment group responses received a full score of 3 points on this question after using Plum, versus 37% of control group responses that earned full credit. We observed responses in the treatment group post-tests not seen in the treatment group pre-tests that used scientific language likely learned from Plum Landing. For example:

- *Deserts are similar to where we live is that plants and animals have their own habitat in order to thrive and live.*
- *Both have plants and animals.*
- *Both are an ecosystem.*

Question 6: Please list one way that the desert is the DIFFERENT from the place where you live.

As with the previous questions, this question revealed a significant difference between the groups. Thirty-five percent of treatment group responses received a full score of 3 points on this question after using Plum, versus 25% of control group responses that earned full credit. We observed more responses in the treatment group post-test that indicated the desert gets less rain compared to where the families lived. Other responses seemed directly connected to Plum Landing content. For example, some responses indicated that water can be found in plants and that desert conditions are harsh all the time. Another child wrote that the desert was more like nature than the urban area where s/he lived. In the control group and treatment group post-test responses, there were still

some misconceptions, such as "there is no grass or snow in the desert," "lack of water in the desert," and "dry desert weather."

Other Measures of Learning

To further explore learning outcomes, we asked parents at pre-test and post-test to report the degree to which they agreed that their children had a basic understanding of (1) the importance of water in the desert and (2) how plants and animals get what they need to survive in a desert. **Over time, we observed significant growth in children's understanding of how plants and animals get what they need to survive in a desert among families that used Plum Landing versus families that did not use Plum.**[7] At pre-test, 75% of control group parents and 84% of treatment group families agreed with the assessment that their children understood how desert plants and animals adapt. By post-test, the proportion of parents who agreed was 84% in the control group and 96% in the treatment group.

There was no observable difference between groups with respect to children's

understanding of the importance of water in the desert. At pre-test, 79% of control group parents and 81% of treatment group families agreed with this assessment of their children's knowledge. By post-test, 96% of control group parents and 98% of treatment group families agreed. So, the amount of growth in both groups was similar over time.[8]

Figure 5. Family Plum project.

We also asked treatment group parents to report on whether their children learned about nature from Plum Landing and whether their children were able to think about how the place where they live is similar to and different from a desert. **We found that almost all treatment group parents (94%) reported that their children learned about nature from Plum Landing and 96% reported that their children were able to think about how their home is different from and similar to a desert.**

Finally, to further explore learning outcomes, we asked students in the treatment group to report whether they discovered anything new from Plum Landing. **Most children (90%) reported that they did learn something new from Plum.** Many examples included information about animals and people. For example:

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[7] $F_{(df = 1, 100)}$ = 5.020, p = .010.
[8] This result indicates that the pre-test survey likely cued families about content to be assessed at post-test, thus prompting them to learn more about deserts between pre-test and post-test. This is one of the weaknesses of using a pre-test and a post-test survey, rather than just a post-test survey.

- *I did not know about bilbies and geckos and that they live in the desert.*
- *How to survive and different desert creatures.*
- *I learned about different animals I could find there.*
- *People can live in deserts.*

Other examples focused on plants. For example:

- *I learned that the desert pea has super-long roots to get the water under the sand.*
- *How the plants keep water.*
- *How the plants have water in the roots.*

Other examples discussed the importance of water. For example:

- *That there is actually water in the desert.*
- *That deserts can flood.*
- *I learned how the rain makes desert lakes. I learned about condensation.*

Other responses discussed how Plum sparked children's interest in exploring nature with their families. For example:

- *I discovered that it would be fun to go out and visit the desert sometime as a field trip with my school or my family; and that it is not something to be afraid of. You just need to be prepared and have a lot of water.*
- *I discovered a lot of new things through this website. I liked the idea of exploring nature and I am going to take mommy with me now.*

Impact 4: Children will be more motivated to learn about their environment as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

*Finding: Children in both groups reported being motivated to learn about their environment from the start of the study, so there was no room for growth. Despite this finding, nearly all treatment group parents (96%) reported that Plum Landing made their children **even more** motivated to learn about nature, even though most of them were motivated to begin with.*

We asked children in both groups to report whether they liked to go outside to learn about their environment. We used "like" as a proxy for motivation, given that our pilot test indicated young children did not understand the word "motivation," but that "wanting" and "liking" to go outside seemed to resonate with them more and mean the same thing to them.

There were no significant differences between the two groups with respect to their motivation to learn about their environment from the outset of the study, and we observed no changes in the treatment group students' reported motivation after using Plum Landing. At pre-test, all but two of the control group children and all of the treatment group children reported they were interested in exploring nature. After using Plum, these proportions did not change significantly, as all children remained interested.

We asked parents in both groups to report whether their children were motivated to go outside and explore nature. Most parents in the control group (77%) and the treatment group (87%) reported at the start of the study that their children were motivated to do so. By the end of the study, 82% of the control group and 94% of the treatment group reported the same – thus, the motivation in both groups grew by a similar amount, so no significant changes were observed. We also asked treatment group parents to report whether Plum Landing specifically made their children more motivated to go outside and explore nature. **Nearly all parents (96%) reported that Plum Landing made their children *more* motivated to learn about nature, even though most of them were anyway.**

Impact 5: Parents will be more interested in exploring environmental science with their children as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

Finding: Plum Landing helped motivate parents to become more interested in exploring environmental science with their children. Plum Landing also helped increase parental enjoyment of exploring nature with their children and significantly strengthened their beliefs in the importance of supporting their children's interest in nature.

We asked parents at pre-test and post-test to indicate whether they were
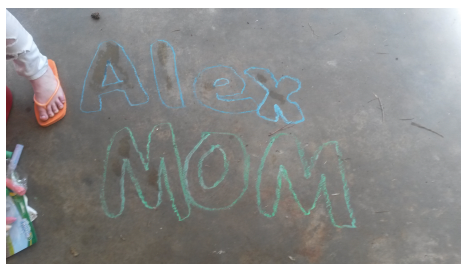
Figure 6. Family time outside.

interested in exploring nature with their children. **We observed a statistically significant improvement in parental interest as a result of using Plum Landing.** Parents in the treatment group were more likely than control group parents to report being interested in exploring nature with their children at post-test versus pre-test.[9]

Related to interest, we also asked parents to indicate whether they enjoyed exploring nature with their children. **We observed a statistically significant**

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[9] $F_{(df = 1, 102)}$ = 5.730, p = .019.

improvement in the degree to which parents reported experiencing enjoyment while exploring nature with their children, as a result of using Plum Landing. Parents in the treatment group were more likely than control group parents to report experiencing enjoyment at post-test versus pre-test.[10]

Beyond interest and enjoyment, we asked parents to report the extent to which they believed that it was **important** for their children to explore nature. Specifically, we asked parents to report their agreement or disagreement with the following statements:

- I think it's important to support my child(ren)'s interest in nature.
- When my child(ren) play outside, it's important that they play sports or do physical activities (like swinging or jumping rope).
- When my child(ren) play outside, it's important that they play games (such as hopscotch or hide and seek).
- When my child(ren) play outside, it's important that they explore nature (such as catching frogs or drawing birds).

Parents in the treatment group showed significant improvement in their beliefs that it was important to support their children's interest in nature, likely as a result of using Plum Landing, while parents' beliefs in the control group did not change.[11] However, there were no observable differences between the groups with respect to the importance that parents placed on their children's explorations of nature when they played outside. All parents believed that it was important for their children to explore nature when they played outside, so no growth was observed.

Impact 6: Parents will be more comfortable exploring environmental science with their children as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

Finding: Parents who used Plum Landing became significantly more comfortable exploring environmental science with their children.

We asked parents in both groups to report their comfort level with helping their children explore nature. **We observed a significant improvement in parent comfort levels as a result of using Plum Landing.** Parents in the treatment group showed more significant growth in comfort levels over time than did control group parents.[12]

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[10] $F_{(df = 1, 101)}$ = 4.381, p = .039.
[11] $F_{(df = 1, 102)}$ = 4.016, p = .048.
[12] $F_{(df = 1, 102)}$ = 3.795, p = .054.

Beyond comfort, but also related to it, we also asked parents to indicate the extent to which they were comfortable that they knew how to support their children's interest in exploring nature. We observed no differences between the groups. At pre-test, 85% of control group parents and 83% of treatment group parents reported that they were comfortable supporting their children's interests in nature. By post-test, these proportions had not changed, so no growth was observed.

Treatment Group Feedback on Plum Landing

Favorite Aspects of Plum Landing

When we asked parents to report what they liked most about Plum Landing, most reported that they and their children had fun with Plum, and that Plum made the learning process enjoyable. For example:

Figure 7. Families enjoyed the hands-on learning.

- *It made learning about nature fun- and educational! My daughter was having so much fun; she didn't realize how much she was learning about nature!*
- *There was a lot of information that my son retained. The site was interesting and the animation kept his attention.*
- *The videos were engaging and explained each topic in a fun manner. Plum Landing made my child more curious about science and nature.*
- *I have to admit; I myself learned something new each time we used the app together; and I tried to play it off as if I already knew this or that. It was good to get information about all sorts of plants and animals and I sort of think of it as a mini vacation getaway.*

- *The activities were engaging and well done. All aspects were educational but done in a fun way!*
- *That it is interactive and keeps my child engaged with fun activities while learning.*

Parents also reported that Plum helped their families feel more motivated to get outside and explore nature together:

- *My child can learn with us as parents and we can explore together.*

- *Plum Landing planted a seed of interest in my child about nature and made it more understandable...this gave me direction to get out and experience with my child the beauty and wonders of nature.*
- *I enjoyed interacting with my son and our nature adventures.*
- *I loved the games and getting outside to explore nature with my son. He loves learning and I love having a platform to grow his interests and increase his knowledge.*
- *I like the website because I think it is great for families so they can do family outdoor activities together.*

Other parents appreciated that the Plum website was age-appropriate for their young children:

- *It was age-appropriate. The characters made nature seem "cool."*
- *I like the educational lessons about nature and the easy to understand format for children. I like the ability to hold my children's interest. I like the Plum character and the easy to relate to children.*

The only complaints from parents we received were about the limited availability of the photo app. About half of the parents explained that they were disappointed that they could not use the app because they did not have an iPhone.

Ninety-five percent of children reported that they "liked" or "loved" the Plum Landing website. When we asked children to describe their favorite part of the Plum Landing website, most of the responses indicated that children enjoyed the games and videos, with many children writing one word responses like "games" or videos." Half of the responses showed that children were interested in hands-on activities. For example, some children reported that they enjoyed: "The missions, and activities we could do at home."

Children's responses also indicated that they had a positive connection with the Plum Landing characters, reporting, for example:

- *The characters were so funny, like how they talk with each other and describe things.*
- *I liked the animation and carton videos.*
- *[My favorites were the] Plum cartoons.*

There were other responses that praised the website's content like the general information it provided, or specific information about animals or the desert. For example, some children reported that they liked:

- *How it gave you a lot of information.*
- *The ideas and also learning about deserts.*

- *When they find the baby shrimp.*
- *Seeing and learning about the different animals.*

In particular, one response went beyond science content about deserts and animals and highlighted the topic of conservation, "I liked all the ideas it gave me about how to make things to save the planet."

Suggestions for Future Episodes

When we asked children what more they would like to see Plum Landing explore in future episodes, there was a wide variety of responses. As is true with other responses throughout the survey, **animals** continued to be a popular topic. For example, children asked for more information about animals in relation to survival, and wanted to know how animals find water or hunt. The sub-theme of survival was also seen when children asked for more information about how humans survive in the desert.

When we asked children where in the world they would like to see Plum Landing explore next, most reported that they were interested in seeing Plum Landing explore the ocean, Africa, and Antarctica, possibly a reflection of the environments explored in Plum Landing.

Two responses mentioned they would like to explore their home or neighborhood, a topic also explored in Plum Landing. One student noted that they would like to explore National Parks in the United States, showing an interest in wanting to learn about natural places closer to home versus outside of the country.

Afterschool Program Study

Study Design

Objectives

In the fall of 2014, CEG designed and carried out a study to evaluate the impact of Plum Landing in afterschool settings. The project's intended impacts are listed below:

Impact 1: Educators will be more **comfortable** exploring environmental science with children as a result of using the Plum Landing afterschool and camp curriculum.

Impact 2: Educators will be more **interested** in exploring environmental science with children as a result of using the Plum Landing afterschool and camp curriculum.

Impact 3: Educators will help children enhance their **environmental habits of mind** (i.e., questions you need to ask when investigating an ecosystem) as a result of using the Plum Landing afterschool and camp curriculum.

Impact 4: Educators will help children learn **environmental science content** as a result of using the Plum Landing afterschool and camp curriculum.

Impact 5: Educators will help nurture children's **enthusiasm** for and **interest** in the environment as a result of using the Plum Landing afterschool and camp curriculum.

Impact 6: Educators will help nurture children's **motivation** to learn about their environment as a result of using the Plum Landing afterschool and camp curriculum.

Recruitment

CEG conducted a study with afterschool programs from four different states. We recruited programs by contacting those which had previously participated in, or indicated an interest in participating in, a study with CEG. First, we contacted program directors to explain the study and determine their eligibility. Programs were eligible to participate if they met the following criteria:

- Programs must serve children aged 7-9 years,

- Programs must have at least occasional access to the Internet,
- Programs must have access to a mobile device with a built-in camera or a digital camera, and
- Programs must be able to meet with the same students to do study activities several times during a 2-4 week period.

Participants

Eight programs participated in the afterschool study. The table below summarizes the key characteristics of the programs in the study. Two out of eight of the treatment programs were based in Massachusetts so that we could easily visit and observe. The other two treatment programs were located in Illinois and Missouri. Each group included a mixture of urban, suburban, and rural programs. Half of the participating programs were based at YMCAs (n = 4), while the remaining programs included school-based afterschool programs (n = 2), a library afterschool program (n = 1) and a Girl Scout troop (n = 1). Nearly one-third of the program populations were comprised of children from low-income families (34% of the treatment group and 32% of the control group). The average proportion of African-American children at the treatment group programs was 30%, while the proportion in the control group programs was 14%. Hispanic children comprised 14% of the treatment group program population and 12% of the control group program population.

Table 3:
Program Characteristics

Program Characteristics	Treatment Group Count (n = 4)	Control Group Count (n = 4)
Location		
Massachusetts	2	3
Illinois	1	0
Indiana	0	1
Missouri	1	0
Setting		
Urban	1	2
Suburban	2	1
Rural	1	1
Type of Program		
YMCA	2	2
Scout Troop	0	1
Library	1	0
School-based program	1	1

Program Characteristics	Treatment Group Count (n = 4)	Control Group Count (n = 4)
Average Percent of Special Populations		
African-American	30%	14%
Hispanic, Spanish, Latino/a	14%	12%
Low Income	34%	32%

A total of 126 students, across the eight programs, participated in the study—66 in the treatment group and 60 in the control group. The table below summarizes the genders and ages across both groups. The average age of the students was eight years in the treatment group (standard deviation = 1 year) and nine years in the control group (standard deviation = 1 year). There were no statistically significant differences between the treatment and control groups with respect to gender or age of the students.

We were initially concerned about the age span of the sample, considering the cognitive differences between six year old and 10 or 11 year old children. However, we ran the analyses with and without the outliers and found no differences in the results. Therefore, all of the findings reported in this chapter include the total sample of students, despite their ages.

Table 4:
Student Characteristics

Student Characteristics	Treatment Group Count and Percent (n = 66)	Control Group Count and Percent (n = 60)
Gender		
Female	32 (48.5%)	35 (58.3%)
Male	34 (51.5%)	25 (41.7%)
Age		
Six	8 (12.1%)	0 (0.0%)
Seven	13 (19.7%)	5 (8.3%)
Eight	23 (34.8%)	12 (20.0%)
Nine	22 (33.3%)	29 (48.3%)
Ten	0 (0.0%)	12 (20.0%)
Eleven	0 (0.0%)	2 (3.3%)

Methods and Procedures

We used a randomized block design for the study—meaning that eligible programs (and, as a result, their "blocks" or groups of students) were randomly assigned to either a treatment group or a control group. Students in both groups completed a pre-test survey at the start of the study. After completing the pre-test survey, educators in the treatment group were provided with access to the Plum Landing website and its resources. Educators in the control group were *not* instructed to do anything different than normal.

Some treatment group programs completed the study over a two-week period, while others met less frequently, and completed the study in four weeks. Following are the instructions we provided to educators in the treatment group.

Treatment Group Procedures

Study Instructions

Preparation

The Field Test provides you with 2 weeks (10 days) worth of activities. You may combine days if you like, or stretch out the schedule over a longer period of time -- whatever works best for your program.

We recommend that you take some time to review each of the steps below, especially the activities, to see if you have any questions. You will want to look at the materials required for each activity and may want to ask parents to donate materials in advance. Most of the materials are everyday ones, like sandwich bags, sponges, and empty jars and you should feel free to substitute whenever you need to.

You will also want to try to view the videos on the website in your program classroom to make sure they will play on your technology.

Week 1, Day 1: Operation Evaporation

In "Operation Evaporation," kids explore evaporation and the water cycle not just in the desert, but right in their own neighborhood, too. This pathway was designed as a sequence that weaves together Plum Landing media resources, including animations, videos, and games, with outdoor exploration and hands-on activities. Each day offers approximately one hour of programming.

Today you'll introduce your kids to Plum Landing and to the Australian desert. Start out by having kids watch *The Lost Lake*, a short animated video about the

fate of water in the desert. Then, head outdoors to complete the related hands-on activity *Evaporation Station*. Click here to begin:
http://pbskids.org/plumlanding/educators/pathways/operation_evaporation.html

Week 1, Day 2: Operation Evaporation, continued

Continue exploring water in your neighborhood with the "Explore Some More" activities listed at the end of *Evaporation Station*. If time permits, watch and discuss *The Search for Shrimp*, a short video about adaptation to desert life, when you return indoors. Click here and look for Day 2:
http://pbskids.org/plumlanding/educators/pathways/operation_evaporation.html

Week 1, Day 3: Operation Evaporation, continued

Now that kids have learned a few things about desert life, let them take what they've learned and set it to song! Listen to the song *Deserts Aren't Dead*, and have a discussion using its "Conversation Starters." Wrap up your day by completing the "Explore Some More" ideas. Click here and look for Day 3:
http://pbskids.org/plumlanding/educators/pathways/operation_evaporation.html

Week 1, Day 4: Operation Evaporation, continued

Deserts aren't the only places where water can be scarce. In *Build a Rain Barrel*, see how one family helps their garden survive a midsummer drought. Have kids make their own gauges to measure rainwater. If time permits, wrap up your day by having a discussion using the "Conversation Starters" or completing one or more of the "Explore Some More" activities listed with the video. Click here and look for Day 4:
http://pbskids.org/plumlanding/educators/pathways/operation_evaporation.html

Week 1, Day 5: Operation Evaporation, continued

Wrap up your desert unit by exploring deserts around the world and telling Plum all about YOUR world. Watch *Earth to Blorb: The Desert!*, have a discussion with the "Conversation Starters," and complete one of the related "Explore Some More" activities. End the day with a sharing session where kids read aloud their letters to Plum. Click here and look for Day 5:
http://pbskids.org/plumlanding/educators/pathways/operation_evaporation.html

Week 2, Day 1: Water in your World

In "Water in your World," kids explore the many roles of water in ecosystems, learn how people affect water resources such as lakes, rivers, and even the ocean, and see how they can help keep our waterways clean. This pathway was

designed with a sequence that weaves together Plum Landing media resources, including animations, videos, and games, with outdoor exploration and hands-on activities. Each day offers approximately one hour of programming.

Today you'll introduce your kids to Plum Landing and to a mangrove swamp in Belize. Start out by having kids watch *River Rollercoaster*, a video showing how water moves through a landscape and carries things with it. Have a discussion using the associated "Conversation Starters," then do the related hands-on activity *Build A Watershed*. If time permits, wrap up your day by completing the "Explore Some More" activities listed with *River Rollercoaster*. Click here and look for Day 1:
http://pbskids.org/plumlanding/educators/pathways/water_in_your_world.html

Week 2, Day 2: Water in your World, continued

Today is all about water in your world. Watch *Follow the Water*, have a discussion using the associated "Conversation Starters," and complete the "Explore Some More" activity. If time permits, wrap up your day by heading outdoors to complete several Plum's Photo Hunt missions. Click here and look for Day 2:
http://pbskids.org/plumlanding/educators/pathways/water_in_your_world.html

Week 2, Day 3: Water in your World, continued

Follow the water all the way to the ocean! Watch *Mangrove Mystery* and *Ocean Odyssey*, then have a discussion using the "Conversation Starters" associated with each video. Head outdoors to complete the "Explore Some More" activity listed at the end of *Ocean Odyssey*. If time permits, complete the "Explore Some More" activity listed with *Mangrove Mystery* as well. Click here and look for Day 3: http://pbskids.org/plumlanding/educators/pathways/water_in_your_world.html

Week 2, Day 4: Water in your World, continued

Now that kids have learned how water moves through landscapes, introduce them to how people sometimes harm watersheds and how kids can help keep waterways clean. Watch *Oliver Takes out the Trash* and *Water Carries Everything*. Then, have a discussion using the "Conversation Starters" associated with both videos, and, if time permits, do one of the "Explore Some More" activities listed with each. Click here and look for Day 4:
http://pbskids.org/plumlanding/educators/pathways/water_in_your_world.html

Week 2, Day 5: Water in your World, continued

Wrap up your water unit by exploring major water resources around the world and telling Plum all about water in YOUR world. Watch *Earth to Blorb: Water!*, have a discussion using the "Conversation Starters," and do the related "Explore Some More" activities. End the day with a sharing session where kids read aloud their letters to Plum. Click here and look for Day 5:
http://pbskids.org/plumlanding/educators/pathways/water_in_your_world.html

Treatment Group Fidelity

All four afterschool programs were able to complete the two required pathways described above. There were a couple of different obstacles reported by educators:

(1) Rainy weather caused delays in some programs.
(2) Some students were self-conscious about creating a song during Week 1, Day 3, so the educator made an adaptation for that session. She reported, "Instead of calling it a song, we called it a chant/cheer so they would not worry about music. Also, I gave them the requirement that they must make their chant at least four lines long."
(3) Due to the nature of afterschool programming, students are dismissed at different times throughout the sessions. As one educator reported, "I had to shorten some of the activities because the kids leave at all times during the program and by the end we would only have a couple kids left.
(4) Some activities were easier for older students than younger ones. As one educator reported, "When I did it with some of my younger kids we made a few modifications (for example, did the project as a group instead of in pairs) to make it a little easier."
(5) Technology limits necessitated some non-ideal, albeit creative, solutions. As one educator reported, "I do not have access to a computer at my program so I would show the video on my work iPhone. The screen was small and hard for all of the kids to see and it was hard for them all to hear the video."

Only one of the programs was able to use the photo app. None of the programs uploaded photos to the Plum website, nor did they send pictures to the evaluation team, due to limited time available for the educators.

At the end of the study, students completed post-test surveys. Due to time constraints and student attrition, two of the four control group sites were unable to collect post-test survey data from all of the participating students. Because there were so few differences between the pre-test and post-test survey responses from the two sites that we did receive data from, we have imputed the missing post-test survey data with pre-test survey data for the control group only.

All surveys were completed on paper and administered by the afterschool educators and shipped to CEG for input and analysis using pre-paid envelopes provided by CEG.

Educator Surveys

In addition to collecting student surveys, we also collected pre-test and post-test survey data from the eight afterschool educators.

Observations

Lastly, CEG conducted in-person observations at the two local treatment group programs in Massachusetts. We observed a single session at each program.

Findings

Below, we have presented the findings summarized by the project's intended impacts.

Impact 1: Educators will be more comfortable exploring environmental science with children as a result of using the Plum Landing afterschool and camp curriculum.

Finding: Plum Landing did not impact educators' comfort levels exploring nature with their students because they had high comfort levels at the outset of study, but Plum Landing did help some educators learn to help their students ask interesting questions about how things work in nature.

We asked educators to indicate how comfortable they were exploring nature with their students. All educators (in both groups) agreed at the start of the study and at the end of the study that they were comfortable exploring nature with their students. Thus, there was no room for growth.[13] In fact, during our observations in two afterschool programs, we observed that both educators appeared to be very comfortable discussing environmental science content with their students, in the context of delivering Plum Landing lessons.

Beyond comfort, but also related to it, we also asked educators to indicate the extent to which they were comfortable that they knew how to:

- Support students' interest in exploring nature, and
- Help students come up with interesting questions about how things work in nature.

In the pre-test survey, all but one educator (from the control group) agreed that they knew how to support students' interest in exploring nature. This control group educator, who had not used Plum Landing resources, reported that she felt the same way during the post-test survey.

Also in the pre-test survey, all but two educators (one from the control group and one from the treatment group) agreed that they knew how to help students come up with interesting questions about how things work in nature. **One treatment group educator (who was previously neutral about helping students formulate questions) agreed that the she did feel more comfortable helping students come up with interesting questions about how things work in**

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[13] For future evaluation studies, we recommend purposely recruiting educators who report that they are *not* comfortable exploring environmental science with their students, so there is a potential to assess whether Plum Landing can change educators' comfort levels.

nature, after using Plum. As with the previous item, the control group educator, who had not used Plum Landing, did not change her report on the post-test survey.

Impact 2: Educators will be more interested in exploring environmental science with children as a result of using the Plum Landing afterschool and camp curriculum.

Finding: Plum Landing did not impact educators' interest in exploring nature with their students because all of the educators reported having high levels of interest at the outset of the study.

We asked educators to report the degree to which they were interested in exploring nature with their students. All educators, in both groups, reported at the start of the study and at the end of the study that they agreed or strongly agreed that they were interested in exploring nature with their students. Thus, there was no room for growth.[14]

We also asked educators to report whether they enjoyed exploring nature with their students. All but one educator (from the control group) agreed that they enjoyed exploring nature with their students. So, there was no room for growth, and none was observed. (By post-test, the control group educator, who had not used Plum Landing, had changed her perspective, and reported that she did indeed enjoy it.)

In addition to (and related to) interest and enjoyment levels, we assessed the degree to which educators believed it was important to support their students' interest in nature, and the degree to which it was important to them that, when their students played outside, they explore nature.

All educators reported that it was important for them to support their students' interest in nature at pre-test, again, leaving no room for growth.

But, at the start of the study, three out of eight educators did not agree that it was important for their students to explore nature when they played outside. Two of these three educators were from the treatment group and one was from the control group. At post-test, after having used Plum Landing, one of the treatment group educators who was neutral at pre-test about the importance of her students exploring nature changed her stance, and agreed that it was important to her. The other treatment group educator, however, remained neutral about whether it was important for her students to explore nature.

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[14] Again, for future studies, we recommend recruiting educators who are *not* interested in exploring environmental science with their students, so there is an opportunity to assess the potential impact of Plum Landing on educators' interest levels.

Finding: Plum Landing helped educators enhance children's environmental habits of mind.

To assess the impact of Plum on students' habits of mind, we asked students: *If you could learn more about deserts or mangroves, what else would you like to know?* We analyzed their responses to look for evidence that students could
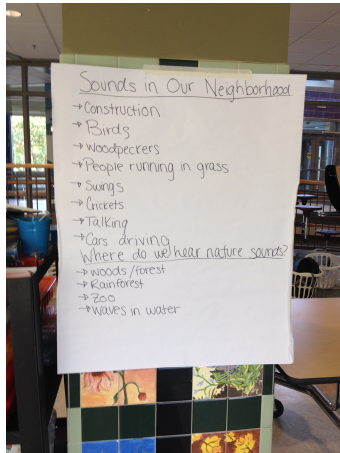
Figure 8. "Sound in Our Neighborhood" poster.

formulate appropriate questions to ask when investigating an ecosystem, and whether there were any noticeable differences between the students who used Plum and the students who did not.

We found evidence that Plum Landing had an impact on the treatment group students' environmental science habits of mind. The treatment group responses indicated that students had learned to ask relevant questions based on information learned from Plum Landing. When compared with the control group, the treatment group responses were more likely to specifically pose insightful, relevant questions such as:

- *How did the fish get there?*
- *How did mangroves grow into that shape?*
- *Why do mangroves have lakes?*

We classified most of the treatment group responses into categories, such as animals and ecosystems. Students whose responses fell into the category of animals posed questions mostly about fish, orangutans, or monkeys. Students whose responses fell into the ecosystem category mostly posed questions about mangroves, such as:

- *Are there rivers or ponds in mangroves?*
- *Why do mangroves have lakes?*
- *Why do fish live in mangroves?*
- *How did the mangroves come true?*
- *How did mangroves grow into that shape?*
- *Do mangroves eat?*
- *Are mangroves in rivers or ponds?*

In the control group, most responses also fell into the categories of animals or ecosystems. But, in contrast to the treatment group, 10 of the 60 control group students were not responsive to the question. Most students in the control group simply asked, "What is a mangrove?" indicating that they did not know what it was, and, therefore, could not formulate relevant questions about mangroves.
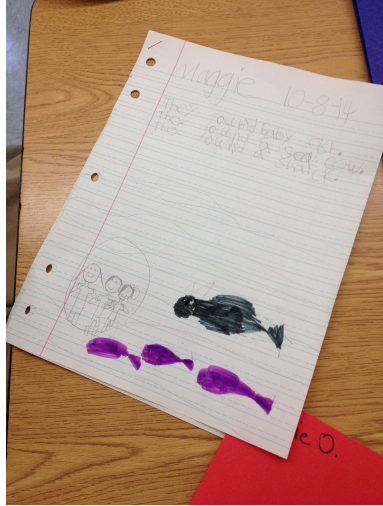
Figure 9. Student reflection on mangrove unit.

Students whose responses fell into the animal category posed questions about different species of animals and wanted to know if there were more animals in the desert or in mangroves. One student posed a question along the lines of survival, asking, "How come animals don't die from heat?"

We also asked educators to report on the extent to which the students in their program were able to formulate interesting questions about how things work in nature. At pre-test, all but one educator from the treatment group reported that their students already asked such questions. By the end of the study, the treatment group educator with students who could not ask interesting questions about nature reported that her students were now formulating relevant questions, likely as a result of using Plum Landing.

Additionally, all the educators (four out of four) who used Plum Landing reported that Plum Landing helped their students ask interesting and appropriate questions about how things work in nature.

Impact 4: Educators will help children learn environmental science content as a result of using the Plum Landing afterschool and camp curriculum.

Finding: Plum Landing helped educators enhance children's environmental science content knowledge.

To assess environmental science content knowledge, we developed a set of 10 questions about deserts and mangroves – two of the four ecosystems covered in Plum Landing (see below for the specific questions). Students earned points for each correct, or partially correct, response. See Appendix C for a summary of the possible points available for each question.

Student pre-test and post-test scores were calculated by summing their points across the questions. Scores on the pre-test ranged from zero to 30 points, while scores on the post-test ranged from zero to 33 points. We also computed

reliability statistics for both scales to ensure their internal consistency (i.e., the degree to which the questions relate to each other and, used together, constitute a single measure of knowledge). Both scales had excellent Cronbach's Alpha reliability coefficients (.87 for the pre-test survey and .89 for the post-test survey).[15]

We found that treatment group students demonstrated significantly greater knowledge of environmental science content knowledge after using Plum Landing than the control group. Treatment group students had an average knowledge score of 15.18 (standard deviation = 9.32) after using Plum while control group students had an average knowledge score of 11.32 (standard deviation = 6.87).[16] This was true, even when we controlled for the age of the students.

While responses from both groups indicated at least a general understanding of desert ecologies, there was a stark difference between the groups with respect to their understanding of mangroves. The treatment group students demonstrated a far greater knowledge than the control group, after having been exposed to Plum Landing. Below, we highlight some of the major differences between the two groups with respect to how they responded to each of the individual questions.

Highlights of Responses to Questions

Question 1: Please list two things that are special about the desert.

Treatment group students demonstrated significantly greater knowledge of things that are special about the desert after using Plum Landing than the control group. Fourteen of the treatment group students received the full four points for their responses to this question, while only eight of the control group students did. We observed more responses in the treatment group than the control group that mentioned the concepts of "little rain" or "not much rain" in the desert. Also, there were more answers in the treatment group that correctly identified that deserts could be hot or cold. Other responses in the treatment group showed a direct connection to Plum Landing content, for example, "dry lake," "spiky lizard," "when it rains it floods," "where there is a dry lake there are shrimp in the dirt," "shrimp," and "when it rains it floods."

Question 2: Please name two animals or plants that live in the desert.

Treatment group students did not demonstrate significantly greater knowledge of animals or plants that live in the desert after using Plum Landing than the control group. Twenty-eight of the treatment group students received the full four points

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[15] As a general rule of thumb, .80 is the minimum coefficient expected for high reliability.
[16] $t_{(df = 119.042)} = 2.666$, $p = .009$.

for their responses to this question, while 24 of the control group students did. There were few differences between the groups' responses. In the treatment group, there were some responses that were not seen in the control group, like "coyote," "red fox," "cobra," "prairie wolf," and "humming bird." However, both groups also included a variety of correct answers. For example, in the control group, some responses included "prickly pear fruit," "saguaro," "cheetah," and "finnic fox."

Question 3: Please list two things that desert plants need to survive.

Treatment group students did not demonstrate significantly greater knowledge of things that desert plants need to survive after using Plum Landing than the control group. Forty-two of the treatment group students received the full four points for their responses to this question, while 32 of the control group students did. There was little difference in the quality of responses between the two groups. Both the treatment group and control group responses included "sand," "water," "sun," or "little water." Because there were more responses like "little water" in the control group, it appeared that students in this group may have understood better that organisms in the desert don't need a lot of water to survive.

Question 4: How do desert animals get what they need to survive?

Treatment group students did not demonstrate significantly greater knowledge of how desert animals get what they need to survive after using Plum Landing than the control group. Sixteen of the treatment group students received the full two points for their responses to this question, while 14 of the control group students did. While there not many differences between the groups, there were several treatment group responses that showed a connection to Plum Landing, such as:

- *Thorned devils wait for rain. Their backs are smooth so the water drifts into their mouth.*
- *They get what they need to survive by collecting water finding animals.*
- *There's lots of sun there. That's their adaptive habitat.*
- *The spiky lizard can have water run down its back into his mouth.*

Question 5: Please list one way that the desert is the SAME as the place where you live.

Treatment group students did not demonstrate significantly greater knowledge of one way that the desert is the same as the place where you live after using Plum Landing than the control group. An equal number of treatment and control group students (19) received the full three points for their responses to this question. Most answers included plants, animals, temperature, and abiotic features like water or sand. Other content relevant responses included, "It's not always hot in

the desert." "We both have fish." "The desert has plants and we have lots of plants." "The desert has trees." and "The desert has a pond."

Treatment group students demonstrated significantly greater knowledge of things that are special about mangroves after using Plum Landing than the control group. Eight of the treatment group students received the full four points for their responses to this question, while only two of the control group students did. We also observed an evident connection to Plum content in the treatment group. For example, in the control group, some correct responses said, "Gives animals homes," "Get water from ocean," "Their roots go in to the water," "They're a group of trees," and "They provide homes to animals." However, students in the treatment group connected their responses to Plum Landing, for example, "The ocean and river meet." "There are roots in the water that baby fish hide in." "The mangroves can protect animals from sharks." and "It is a day care for fish."

Treatment group students demonstrated significantly greater knowledge of animals or plants that live in mangroves after using Plum Landing than the control group. Ten of the treatment group students received the full four points for their responses to this question, while only one of the control group students did. Responses in the treatment group directly connected to Plum Landing. For example, "baby fish" and "Western Indian manatee" were the types of answers we did not observe in the control group.

Treatment group students demonstrated significantly greater knowledge of things that mangrove plants need to survive after using Plum Landing than the control group. Twenty-five of the treatment group students received the full four points for their responses to this question, while only 8 of the control group students did. Treatment group students demonstrated a better understanding than control group students about the ecology of a mangrove, while control group students simply left the question blank.

Treatment group students demonstrated significantly greater knowledge of how mangrove animals get what they need to survive after using Plum Landing than the control group. Ten of the treatment group students received the full two points for their responses to this question, while only one of the control group students did. Compared to the control group, there were some responses from the treatment group that directly connected to Plum Landing content such as, "Monkeys get food by climbing to it in trees." "They swim and when they see prey

they kill it and then eat it." "They live in the water and they get sunlight from the top of the water." "Mangrove animals get what they need to survive by being in the water." These responses clearly connected to Plum videos based on the language used and the types of animals they talked about.

Question 10: Please list one way that mangroves are the SAME as the place where you live.

Treatment group students demonstrated significantly greater knowledge of how mangroves are the same as the place where you live after using Plum Landing than the control group. Ten of the treatment group students received the full three points for their responses to this question, while only five of the control group students did. Some answers exclusively seen in the treatment group highlighted information discussed in Plum. For example, responses that fell into the abiotic category like, "They provide shelter." and "We both have streams." specifically touched on content seen in Plum videos. Additionally, there were more answers that fell into the abiotic category in the treatment group than in the control group, indicating a shift in types of responses as a result of Plum Landing.

Other Measures of Learning

We asked treatment group educators to report whether their students learned anything about nature from Plum Landing. **All of the educators (four out of four) reported that Plum Landing taught their students something about nature.**

We also asked students in the treatment group to report whether they learned anything new from Plum Landing. Students reported that most of the new information they learned was related to animals, mangroves, water, and deserts.

Students who learned about mangroves reported that they learned what they were, that they're different from deserts, that they're "fish nurseries", that they are plants and are in rivers, and have one root. We noted that information about shrimp and mangroves as fish nurseries impacted more than one student. For example, as one student reported, "I learned that shrimp lay their eggs in the sand and when it rains they swim in the water lay their eggs."

Other topics students reported learning about included water and deserts. Students wrote about both evaporation and water. For example, students reported, "I learned that deserts sometimes are cold." and "I learned there was water in the desert." Responses related to conservation included, "I learned never to pollute the water" and "Do not waste water."

Impact 5: Educators will help nurture children's enthusiasm for and interest in the environment as a result of using the Plum Landing afterschool and camp curriculum.

Finding: Both groups of students reported being interested in exploring nature from the start, and there were no observable changes after using Plum Landing. However, one educator--in a program where the students were not as interested--reported that her students became more interested in exploring nature after using Plum Landing.

We asked students in both groups to report whether they were interested in exploring nature. Most students in both groups reported they were interested in exploring nature at the start of the study. At pre-test 60% of the control group and 71% of the treatment group were interested in exploring nature. After using Plum, these proportions did not change significantly (60% and 70%, respectively).

We also asked educators at pre-test and post-test to report the extent to which the students in their program were interested in exploring nature. All educators, except for one in the treatment group and one in the control group, reported that their students were interested in exploring nature. **By the end of the study, the educator who reported that her students were not interested in nature reported that, after using Plum Landing, her students were now more**

Figure 10. Educator projected videos from her laptop.

interested in exploring nature. The control group educator's position did not change.

We also asked treatment group educators to report whether Plum Landing helped their students become more interested in learning about nature. **Three out of four educators reported that Plum Landing made their students *more* interested in learning about nature, even though most of them were interested to begin with.** The fourth educator reported that her students already *were* interested in nature, so there was no room for change.

During our in-person observations at two of the treatment group programs, we observed that most students were **very actively engaged** during the sessions, for at least the first 30 minutes in each location. After 45 minutes, students began to get distracted easily. In both programs, parents started to arrive between 45 and 60 minutes into our observation.

At one location, the students all hummed the Plum Landing theme song repeatedly throughout the session. It appeared that they all enjoyed the activities and were excited to learn more about Plum, her friends, and their latest

adventures. When they learned it was time for Plum, they eagerly put away their other books and papers and paid very close attention to the educator. They paid full attention during the video (which the educator displayed on a whiteboard using a projector from her laptop – see figure) and laughed along with the characters at appropriate times.

At the other location, the kids worked mainly outside on the sidewalk and in the grass, listening to the sounds of nature. We did not observe them watching videos, but the children did tell the observer that they looked forward to watching the Plum videos. Even though the children were young, the activity kept their attention for a full 30 minutes (until parents started arriving to pick children up).

Impact 6: Educators will help nurture children's motivation to learn about their environment as a result of using the Plum Landing afterschool and camp curriculum.

Finding: Both groups of students reported being motivated to learn about their environment from the start, and there were no observable changes after using Plum Landing. However, some educators did report an increase in their students' motivation to learn about the environment after using Plum.

We asked students in both groups to report whether they liked to go outside to learn about their environment. We used "like" as a proxy for motivation, given that our pilot test indicated young children did not understand the word "motivation," but that "wanting" and "liking" to go outside seemed to resonate with them more and mean the same thing to them.
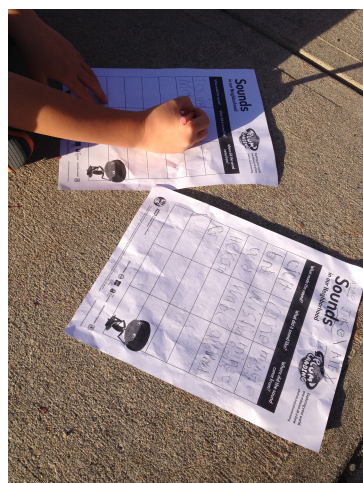
Figure 11. Students worked in pairs outside during the Sounds activity.

There were no significant differences between the two groups with respect to their motivation to learn about their environment from the outset of the study, and we observed no changes in the treatment group students' reported motivation after using Plum Landing. At pre-test, 53% of the control group and 65% of the treatment group were interested in exploring nature. After using Plum, these proportions did not change significantly (53% and 62%, respectively).

We asked educators in both groups to report whether their students were motivated to go outside and explore nature. All, but one educator (from the treatment group) reported that their students were motivated to do so. **The educator who previously**

reported that her students were not motivated to go outside and explore, reported a positive change in her students' motivation by the end of the study, after using Plum Landing.

We also asked treatment group educators to report whether Plum Landing specifically made their students more motivated to go outside and explore nature. **Three out of four educators reported that Plum Landing made their students *more* motivated to learn about nature, even though most of them were anyway.** As reported above, the fourth educator reported that her students already *were* motivated, so there was no room for change.

Anecdotally, educators reported:

- *The kids were interested in doing more lessons in the future. An afterschool program could easily use this regularly with their kids and have possibly enough science activities for the year. The kids were also motivated by going online and seeing the pictures they took there. Great job once again, WGBH!*

- *My students saw some of the other areas that Plum visited and want to learn about those areas, too.*

During our in-person observations at two treatment group programs, we observed, in both locations, that students were very eager to show us what they had learned about deserts and mangroves. Below are some examples of drawings and letters that students wrote to Plum about what they had learned.
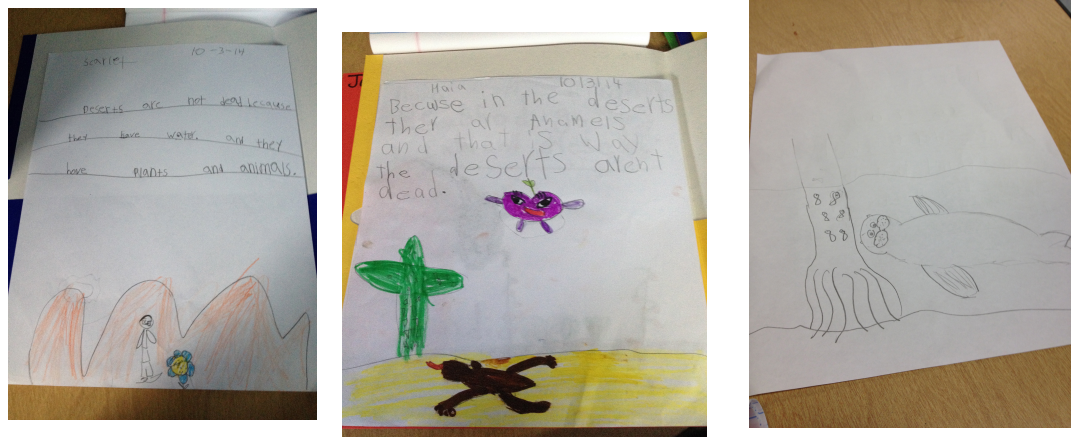
Figure 12. Examples of student work.

Treatment Group Feedback on Plum Landing

Uniformly, feedback from afterschool educators about Plum Landing was positive. All afterschool educators who used Plum in their programs reported that Plum Landing was **engaging** for them and their students. For example, one educator reported, "Plum Landing was...entertaining for both students and educators. The missions and animation were wonderful (ways) to follow and visualize the exploration." Another educator, familiar with other digital curricula, reported, "This is really a groundbreaking site."

Educators reported that they and their students enjoyed the interactivity of the digital curriculum components and that the experience **motivated** their students to do more activities like the ones they tried in the study or to learn more about the topics covered. For example, one educator reported, "(It was a) very interactive website so the students and I enjoyed clicking away and exploring all the resources." Others reported that their students were eager to try more Plum Landing pathways after the study ended. Additionally, students were motivated by the fact that their pictures appeared online, "They also were motivated by going online and seeing the pictures they took there." Furthermore, two educators reported, "The kids saw some of the other areas that Plum visited and want to learn about those areas." and "...the students wanted more, but that gives me the chance to have them do a little research on their own."

All afterschool educators reported that digital curriculum **supported their ability to teach** their students about environmental science. For example, one educator reported, "The descriptions were great and helped guide the educator into a smooth transition when having discussions." Another educator reported, "An afterschool program could easily use this regularly with their kids and have possibly enough science activities for the year."

Educators reported that one strength of the curriculum lies in the **age-appropriate science content**. One educator reported, "(The videos) are extremely age appropriate. The kids were able to remember facts from the videos shown the previous week when I asked them questions at the start of the next meeting one week later."

Educators reported that other strengths lie in the **format and accessibility** of the curriculum. Educators found the content to be well planned out, and easy to follow. Several educators reported that "...the videos and activities were easy to follow and short." Others reported, "It was also nice to have the activities and questions all laid out for me." and "It was very easy to navigate through."

All of the educators also appreciated that the materials required for the hands-on activities were "**inexpensive supplies** that most sites readily have access to."

For example, one educator reported, "I liked that the materials for the most part were very simple and we already had most of them at our program."

Suggestions for Future Episodes

Finally, when we asked treatment group students where in the world they would like to see Plum Landing explore next, most reported that they were interested in seeing Plum Landing explore forests, oceans, or Antarctica.

Summary of Findings

Findings Organized by Impact

> *I discovered a lot of new things through this website. I liked the idea of exploring nature and I am going to take mommy with me now.*
>
> *- 8-year old boy from urban area of CA*

The evaluation studies found that Plum Landing had a significant impact on children, parents, and educators.

In family and afterschool settings, Plum Landing helped to enhance children's environmental habits of mind, encouraging them to ask interesting questions about how things work in nature and formulate relevant questions about environmental science. Also, in family and afterschool settings, Plum Landing had a significant educational impact on children's knowledge of environmental science content.

Plum Landing helped nurture children's enthusiasm and interest for exploring the environment, especially in home settings. Despite the fact that most children in our samples were already highly motivated to learn about the environment from the start of the study, most parents reported that Plum Landing helped their children become *even more* motivated.

In home settings, Plum Landing was successful at motivating parents to become more interested in exploring environmental science with their children. Plum also helped them learn to enjoy it more, as well as strengthening parental beliefs in the importance of supporting their children's interest in nature. Plum also made parents significantly more comfortable exploring environmental science with their children.

While Plum Landing did not impact educators' comfort or interest levels exploring nature with their students (because they had high levels at the outset of study), Plum Landing did help educators enhance their students' environmental habits of mind, environmental knowledge, and, in some cases, students' interest in environmental science.

Below, we summarize the major findings from the Family Study and the Afterschool Program Study, organized by intended project impacts.

Family Study Impact 1: Children's **environmental habits of mind** (i.e., questions you need to ask when investigating an ecosystem) will be enhanced as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

- Plum Landing **enhanced children's environmental habits of mind.**

- Parents in the treatment group were significantly more likely to report that their children **asked interesting questions about how things work in nature, after using Plum Landing.**

- Most parents (88%) agreed that **Plum Landing helped their child formulate relevant questions about environmental science.**

Family Study Impact 2: Children's **enthusiasm for and interest in the environment** will increase as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

- Plum Landing **enhanced children's interest in exploring the environment.**

- Treatment group children showed a statistically significant **improvement in their interest in exploring nature, after using Plum Landing.**

- Parents in the treatment group were more likely than control group parents to report, at post-test, that their children were **interested in nature.**

- Forty-nine out of 52 parents (94%) agreed that **Plum Landing helped their child become more interested in exploring nature.**

Family Study Impact 3: Children will **learn environmental science content** as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

- Plum Landing **enhanced children's environmental science content knowledge.**

- **Treatment group children demonstrated significantly greater knowledge of environmental science content knowledge after using Plum than the control group.**

- While responses from both groups indicated at least a general understanding of desert ecologies, the treatment group responses referred to **specific content (certain animals, plants, animal habits, professional jobs associated with the desert, etc.)** that was not observed in control group responses.

- Over time, there was **significant growth in children's understanding of how plants and animals get what they need to survive in a desert**

among families that used Plum Landing versus families that did not use Plum.

- **Almost all treatment group parents (94%) reported that their children learned about nature from Plum Landing and 96% reported that their children were able to think about how their home is different from and similar to a desert.**

- **Most children (90%) reported that they learned something new from Plum.**

Family Study Impact 4: Children will be more **motivated to learn about their environment** as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

- Children in both groups reported being motivated to learn about their environment from the start of the study, so there was no room for growth.

- Despite this finding, **nearly all treatment group parents (96%) reported that Plum Landing made their children** *even more* **motivated to learn about nature, even though most of them were motivated to begin with.**

Family Study Impact 5: Parents will be more **interested in exploring environmental science with their children** as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

- Plum Landing helped motivate parents to become **more interested in exploring environmental science with their children.** There was a statistically significant improvement in parental interest as a result of using Plum Landing.

- Plum Landing also helped **increase parental enjoyment of exploring nature with their children** and **significantly strengthened their beliefs in the importance of supporting their children's interest in nature.**

Family Study Impact 6: Parents will be **more comfortable exploring environmental science with their children** as a result of visiting the Plum Landing site and interacting with the Plum Landing resources.

- Parents who used Plum Landing became **significantly more comfortable exploring environmental science with their children.**

Afterschool Study Impact 1: Educators will be more **comfortable** exploring environmental science with children as a result of using the Plum Landing afterschool and camp curriculum.

- Plum Landing did not impact educators' comfort levels exploring nature with their students because they had high comfort levels at the outset of study.

- One treatment group educator (who was previously neutral about helping students formulate questions) agreed that the she did feel **more comfortable helping students come up with interesting questions about how things work in nature, after using Plum.**

- During our observations in two afterschool programs, we observed that **both educators appeared to be very comfortable discussing environmental science content with their students in the context of delivering Plum Landing lessons.**

Afterschool Study Impact 2: Educators will be more **interested** in exploring environmental science with children as a result of using the Plum Landing afterschool and camp curriculum.

- Plum Landing did not impact educators' interest in exploring nature with their students because all of the educators reported having high levels of interest at the outset of the study.

Afterschool Study Impact 3: Educators will help children enhance their **environmental habits of mind** (i.e., questions you need to ask when investigating an ecosystem) as a result of using the Plum Landing afterschool and camp curriculum.

- Plum Landing helped educators enhance children's environmental habits of mind. The treatment group responses indicated that **students had learned to ask relevant questions based on information learned from Plum Landing. When compared with the control group, the treatment group responses were more likely to specifically pose insightful, relevant questions about how things work in nature, likely as a result of using Plum Landing.**

Afterschool Study Impact 4: Educators will help children learn **environmental science content** as a result of using the Plum Landing afterschool and camp curriculum.

- Plum Landing helped educators enhance children's environmental science content knowledge. **Treatment group students demonstrated significantly greater knowledge of environmental science content knowledge after using Plum than the control group.**

- While responses from both groups indicated at least a general understanding of desert ecologies, **there was a stark difference between the groups with respect to their understanding of mangroves.**

- **All the educators (four out of four) reported that Plum Landing taught their students something about nature.**

- Students reported that most of the new information they learned related to **animals, mangroves, water, and deserts.**

Afterschool Study Impact 5: Educators will help nurture children's **enthusiasm** for and **interest** in the environment as a result of using the Plum Landing afterschool and camp curriculum.

- Both groups of students reported being interested in exploring nature from the start, and there were no observable changes after using Plum Landing. However, **one educator--in a program where the students were not as interested--reported that her students became more interested in exploring nature after using Plum Landing.**

- **Three out of four educators reported that Plum Landing made their students *more* interested in learning about nature, even though most of them were interested to begin with.** The fourth educator reported that her students already *were* interested in nature, so there was no room for change.

Afterschool Study Impact 6: Educators will help nurture children's **motivation** to learn about their environment as a result of using the Plum Landing afterschool and camp curriculum.

- Both groups of students reported being motivated to learn about their environment from the start, and there were no observable changes after using Plum Landing. However, **some educators did report an increase in their students' motivation to learn about the environment after using Plum.**

- The educator who previously reported that her students were not motivated to go outside and explore, reported a **positive change in her students' motivation by the end of the study, after using Plum Landing.**

Other Findings

Uniformly, feedback from families and afterschool educators about Plum Landing was positive.

When we asked children to describe their favorite part of the Plum Landing website, many responses showed that children were interested in hands-on activities, games and videos. Children's responses also indicated that they had a positive connection with the Plum Landing characters. There were other responses that praised the website's content, like the general information it provided, or specific information about animals or the desert.

Recommendations for Future Plum Activities and Evaluation Studies

When we asked treatment group students where in the world they would like to see Plum Landing explore next, most reported that they were interested in seeing Plum Landing explore forests, oceans, or Antarctica. We suggest that WGBH consider creating Plum adventures that include one or more of these regions of interest.

The only complaint we received from parents was about the limited availability of the photo app. About half of the parents explained that they were disappointed that they could not use the app because they did not have an iPhone. We strongly encourage WGBH to consider providing an Android compatible version of the photo app.

For future evaluation studies, we recommend purposively recruiting parents and educators who report they are *not* comfortable exploring environmental science with their children/students, so there is a potential to assess whether Plum Landing can change adults' comfort levels. Likewise, we recommend recruiting adults who are *not* interested in exploring environmental science with their children/students, so there is an opportunity to assess the potential impact of Plum Landing on adults' interest levels.

Appendix A: Family Surveys

Family Survey - Control Group

Survey Instructions - Parents Please Read

If your child needs help reading the questions because they can't read yet, it's OK if you read to them.

If your child needs help typing the answers because they can't spell yet, it's OK if you type for them.

But, please do not help your child come up with the answers. Please type only what your child says, as if they were saying it (typos and grammatical errors are OK!). Please do not change or correct your child's answers, even if you think they are wrong. It is very important for us to hear from the kids in their own words. And, it's OK if they get an answer wrong. That's important for us to know, too.

*1. Parent first name:

*2. Parent last name:

*3. Child's first name:

4. Parents, some parents don't allow their children to play outside. Do you allow your child (ren) to play outside?

◯ Yes, when possible

◯ Never

5. Parents, please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I don't know
When my child(ren) play outside, it's important that they play sports or do physical activities (like swinging or jumping rope).	◯	◯	◯	◯	◯	◯
When my child(ren) play outside, it's important that they play games (such as hopscotch or hide and seek).	◯	◯	◯	◯	◯	◯
When my child(ren) play outside, it's important that they explore nature (such as catching frogs or drawing birds).	◯	◯	◯	◯	◯	◯
I have to help my child(ren) decide what activities to do outside.	◯	◯	◯	◯	◯	◯
My child(ren) always come up with their own ideas about what to play outside.	◯	◯	◯	◯	◯	◯

6. Parents, please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I don't know
I am interested in exploring nature with my child(ren).	○	○	○	○	○	○
I enjoy exploring nature with my child(ren).	○	○	○	○	○	○
I think it's important to support my child(ren)'s interest in nature.	○	○	○	○	○	○
I know how to support my child(ren)'s interest in exploring nature.	○	○	○	○	○	○
I am comfortable exploring nature with my child(ren).	○	○	○	○	○	○

7. Parents, please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I don't know
My child is interested in learning about nature.	○	○	○	○	○	○
My child is motivated to go outside and explore nature.	○	○	○	○	○	○
My child asks interesting questions about how things work in nature.	○	○	○	○	○	○
My child has a basic understanding of the importance of water in the desert.	○	○	○	○	○	○
My child has a basic understanding of how plants and animals get what they need to survive in a desert.	○	○	○	○	○	○

The remaining questions are for your child to answer.

If your child needs help reading the questions because they can't read yet, it's OK if you read to them.

If your child needs help typing the answers because they can't spell yet, it's OK if you type for them.

But, please do not help your child come up with the answers. Please type only what your child says, as if they were saying it (spelling and grammatical errors are OK!). Please do not change or correct your child's answers, even if you think they are wrong. It is very important for us to hear from the kids in their own words. And, it's OK if they get an answer wrong. That's important for us to know, too.

8. KIDS: Are you interested in exploring nature?

○ Yes

○ Sometimes

○ No

○ I don't know

9. KIDS: Do you like to go outside to learn more about nature?

○ Yes

○ Sometimes

○ No

○ I don't know

KIDS: Next, are some questions that will help us learn what kids know about nature. It's OK to guess! But, please don't ask anyone else for help. We want to know what YOU think.

10. KIDS: Please list 3 things that are special about the desert.

1

2

3

11. KIDS: Please name 3 animals or plants that live in the desert.

1

2

3

12. KIDS: Please list 3 things that desert animals and plants need to survive.

1

2

3

13. KIDS: How do desert animals and plants get what they need to survive?

14. KIDS: Please list one way that the desert is the SAME as the place where you live:

15. KIDS: Please list one way that the desert is DIFFERENT from the place where you live:

16. KIDS: If you could learn more about deserts, what else would you like to know?

PRE AND POST-TEST SURVEY QUESTIONS

Survey Instructions - Parents Please Read

If your child needs help reading the questions because they can't read yet, it's OK if you read to them.

If your child needs help typing the answers because they can't spell yet, it's OK if you type for them.

But, please do not help your child come up with the answers. Please type only what your child says, as if they were saying it (typos and grammatical errors are OK!). Please do not change or correct your child's answers, even if you think they are wrong. It is very important for us to hear from the kids in their own words. And, it's OK if they get an answer wrong. That's important for us to know, too.

*1. Parent first name:

[   ]

*2. Parent last name:

[   ]

*3. Child's first name:

[   ]

POST-TEST ONLY

*4. Parents, have you explored the Plum Landing website with your child?

◯ Yes

◯ No

*5. Parents, have you downloaded and used the Plum's Photo Hunt App?

◯ Yes

◯ No (Please explain)

[   ]

*6. Parents, which of the online games did your child play? (Please choose all that apply)

☐ Explore the Outback - In this photo safari, kids earn points by taking pictures of specific desert plants and animals

☐ Feed the Dingo - In this game, kids try to put together a balanced desert ecosystem, in which each animal has enough food to survive for 12 days

☐ Neither

*7. Parents, which of the animations (cartoons) did your child watch? (Please choose all that apply)

☐ The Lost Lake - Desert 1 - Bubble off to the Australian desert with Cooper, Clem and Brad to find a missing lake!

☐ The Search for Shrimp - Desert 2 - Join Gabi and Oliver on their new mission.

☐ Digging for Clues - Desert 3 - Join Brad and Clem on another fun mission from Plum - The Search for a Sturt's Desert Pea.

☐ Earth to Blorb: The Desert! - "Everything You Ever Wanted to Know about the Desert," for the folks back home on Blorb.

☐ Deserts Aren't Dead (Desert Song) - Join Brad's video sing-along: Zombies and mummies might be dead, but deserts sure aren't!

☐ Brad Defriends a Bilby - Whem Plum finds Brad's "pet" bilby, she wants it returned to the desert fast!

☐ None of the above

*8. Parents, which of the live action (real people) videos did your child watch? (Please choose all that apply)

☐ Build a Rain Barrel - How does your garden grow? Join Kiana, Kaya, and Kalea as they battle a summer drought.

☐ Visit a Vernal Pool - Going, going...gone! Join three sisters as they observe an ever-changing vernal pool.

☐ Race to Save Water - Kiana, Kaya, and Kalea compete with their neighbors to save water. On your mark, get set...

☐ None of the above

*9. Parents, which of the one hour activities did you and your child try? (Please choose all that apply)

☐ Evaporation Station - In this activity, kids experiment to see how sun, shade and wind affect how water evaporates.

☐ Roots and Shoots - In this activity, kids model how different characteristics, such as leaf thickness and a protective waxy coating, help plants store water and keep from drying out.

☐ Neither

*10. Parents, did you TAKE any photos using the Photo App? If so, how many?

○ None

○ 1-2

○ 3-5

○ More than 5

*11. Parents, did you UPLOAD any photos using the Photo App? If so, how many?

○ None

○ 1-2

○ 3-5

○ More than 5

12. If you uploaded pictures, what was the name or label you used (e.g., #PlumCP)?

PRE AND POST-TEST QUESTIONS

13. Parents, some parents don't allow their children to play outside. Do you allow your child(ren) to play outside?

○ Yes, when possible

○ Never

14. Parents, please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I don't know
When my child(ren) play outside, it's important that they play sports or do physical activities (like swinging or jumping rope).	○	○	○	○	○	○
When my child(ren) play outside, it's important that they play games (such as hopscotch or hide and seek).	○	○	○	○	○	○
When my child(ren) play outside, it's important that they explore nature (such as catching frogs or drawing birds).	○	○	○	○	○	○
I have to help my child(ren) decide what activities to do outside.	○	○	○	○	○	○
My child(ren) always come up with their own ideas about what to play outside.	○	○	○	○	○	○

15. Parents, please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I don't know
I am interested in exploring nature with my child(ren).	◯	◯	◯	◯	◯	◯
I enjoy exploring nature with my child(ren).	◯	◯	◯	◯	◯	◯
I think it's important to support my child(ren)'s interest in nature.	◯	◯	◯	◯	◯	◯
I know how to support my child(ren)'s interest in exploring nature.	◯	◯	◯	◯	◯	◯
I am comfortable exploring nature with my child(ren).	◯	◯	◯	◯	◯	◯

16. Parents, please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I don't know
My child is interested in learning about nature.	◯	◯	◯	◯	◯	◯
My child is motivated to go outside and explore nature.	◯	◯	◯	◯	◯	◯
My child asks interesting questions about how things work in nature.	◯	◯	◯	◯	◯	◯
My child has a basic understanding of the importance of water in the desert.	◯	◯	◯	◯	◯	◯
My child has a basic understanding of how plants and animals get what they need to survive in a desert.	◯	◯	◯	◯	◯	◯

POST-TEST ONLY

17. Parents, please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I don't know
Plum Landing made my child more interested in learning about nature.	○	○	○	○	○	○
Plum Landing helped motivate my child to go outside and explore nature.	○	○	○	○	○	○
Plum Landing helped my child ask interesting and appropriate questions about how things work in nature.	○	○	○	○	○	○
My child learned about nature from Plum Landing.	○	○	○	○	○	○
My child was able to think about how the place where we live is similar to and different from a desert.	○	○	○	○	○	○
My child used the Nature Sketchpad, and/or the photo app to make observations about nature.	○	○	○	○	○	○

18. Parents, what do you like BEST about Plum Landing?

19. Parents, what do you like LEAST about Plum Landing?

20. Parents, did you have any problems during the study? If so, how did you handle them?

21. Parents, will you continue visiting the Plum Landing website with your child? Please explain.

PRE AND POST-TEST QUESTIONS

The remaining questions are for your child to answer.

If your child needs help reading the questions because they can't read yet, it's OK if you read to them.

If your child needs help typing the answers because they can't spell yet, it's OK if you type for them.

But, please do not help your child come up with the answers. Please type only what your child says, as if they were saying it (spelling and grammatical errors are OK!). Please do not change or correct your child's answers, even if you think they are wrong. It is very important for us to hear from the kids in their own words. And, it's OK if they get an answer wrong. That's important for us to know, too.

22. KIDS: Are you interested in exploring nature?

◯ Yes

◯ Sometimes

◯ No

◯ I don't know

23. KIDS: Do you like to go outside to learn more about nature?

◯ Yes

◯ Sometimes

◯ No

◯ I don't know

KIDS: Next, are some questions that will help us learn what kids know about nature. It's OK to guess! But, please don't ask anyone else for help. We want to know what YOU think.

24. KIDS: Please list 3 things that are special about the desert.

1 [   ]

2 [   ]

3 [   ]

25. KIDS: Please name 3 animals or plants that live in the desert.

1 [   ]

2 [   ]

3 [   ]

26. KIDS: Please list 3 things that desert animals and plants need to survive.

1 [   ]

2 [   ]

3 [   ]

27. KIDS: How do desert animals and plants get what they need to survive?

[   ]

28. KIDS: Please list one way that the desert is the SAME as the place where you live:

[   ]

29. KIDS: Please list one way that the desert is DIFFERENT from the place where you live:

[   ]

30. KIDS: If you could learn more about deserts, what else would you like to know?

[   ]

POST-TEST ONLY

31. KIDS: What more would you like to see Plum Landing explore in future desert episodes?

[text box]

32. KIDS: Did you like the Plum Landing website?

○ I loved it

○ I liked it

○ I didn't like it that much

○ I didn't like it at all

33. KIDS: What was your favorite part of the Plum Landing website?

[text box]

34. KIDS: Did you discover anything new from Plum Landing? If yes, please tell us about what you learned.

[text box]

35. KIDS: Where in the world would you like to see Plum Landing explore next?

[text box]

Appendix B: Afterschool Program Study Surveys

First Name _____

Student Survey, Parts 1 & 2

Instructions:

Please do your best to answer the survey questions.

Please work alone.

If you don't know an answer – it's OK to guess or to skip a question.

Please give the survey packet back to your afterschool leader when you are done.

THANK YOU!

Part 1

1. Are you a
    a. Girl
    b. Boy

2. How old are you?
    a. 7
    b. 8
    c. 9
    d. Other: _____

3. Which of the following best describes you? (Circle all that apply)
    a. Caucasian or White
    b. Hispanic, Latino, or Spanish
    c. Black or African-American
    d. Asian American
    e. Native American or Pacific Islander
    f. Native American or Alaskan Native
    g. Other (please describe): _____

4. Are you interested in exploring nature? (Circle one)
    a. Yes
    b. No
    c. I don't know

5. Do you like to go outside to try to learn more about nature? (Circle one)
    a. Yes
    b. No
    c. I don't know

6. Please list two things that are special about **the desert**:

    a. _____

    b. _____

7. Please name two animals or plants that live in **the desert**:

    a. _____

    b. _____

8. Please list two things that **desert** plants need to survive:

    a. _____

    b. _____

9. How do **desert** animals get what they need to survive?

10. Please list one way that **the desert** is the SAME as the place where you live:

    a. _____

11. Please list two things that are special about **mangroves**:

    a. _____

    b. _____

12. Please name two animals or plants that live in **mangroves**:

      a. _____

      b. _____

13. Please list two things that **mangrove** plants need to survive:

      a. _____

      b. _____

14. How do **mangrove** animals get what they need to survive?

15. Please list one way that **mangroves** are the SAME as the place where you live?

      a. _____

16. If you could learn more about deserts or mangroves, what else would you like to know?

STOP!

DO NOT remove the staple.

Please give the packet to your afterschool leader.

Part 2

1. Are you interested in exploring nature? (Circle one)

    a. Yes

    b. No

    c. I don't know

2. Do you like to go outside to try to learn more about nature? (Circle one)

    a. Yes

    b. No

    c. I don't know

3. Please list two things that are special about **the desert**:

    a. _____

    b. _____

4. Please name two animals or plants that live in **the desert**:

    a. _____

    b. _____

5. Please list two things that **desert** plants need to survive:

    a. _____

    b. _____

6. How do **desert** animals get what they need to survive?

7. Please list one way that **the desert** is the SAME as the place where you live:

    a. _____

8. Please list two things that are special about **mangroves**:

    a. _____

    b. _____

9. Please name two animals or plants that live in **mangroves**:

    a. _____

    b. _____

10. Please list two things that **mangrove** plants need to survive:

    a. _____

    b. _____

11. How do **mangrove** animals get what they need to survive?

12. Please list one way that **mangroves** are the SAME as the place where you live?

      a. _____

13. If you could learn more about deserts or mangroves, what else would you like to know?

Thank you! Please return this survey to your afterschool leader.

First Name _____

Field Test

Student Surveys, Parts 1 & 2

Instructions:

Please do your best to answer the survey questions.

Please work alone.

If you don't know an answer – it's OK to guess or to skip a question.

Please give the survey packet back to your afterschool leader when you are done.

THANK YOU!

Part 1

1. Are you a
   a. Girl
   b. Boy

2. How old are you?
   a. 7
   b. 8
   c. 9
   d. Other: _____

3. Which of the following best describes you? (Circle all that apply)
   a. Caucasian or White
   b. Hispanic, Latino, or Spanish
   c. Black or African-American
   d. Asian American
   e. Native American or Pacific Islander
   f. Native American or Alaskan Native
   g. Other (please describe): _____

4. Are you interested in exploring nature? (Circle one)
   a. Yes
   b. No
   c. I don't know

5. Do you like to go outside to try to learn more about nature? (Circle one)
   a. Yes
   b. No
   c. I don't know

6. Please list two things that are special about **the desert**:

   a. _____

   b. _____

7. Please name two animals or plants that live in **the desert**:

   a. _____

   b. _____

8. Please list two things that **desert** plants need to survive:

   a. _____

   b. _____

9. How do **desert** animals get what they need to survive?

10. Please list one way that **the desert** is the SAME as the place where you live:

   a. _____

11. Please list two things that are special about **mangroves**:

   a. _____

   b. _____

12. Please name two animals or plants that live in **mangroves**:

      a. _____

      b. _____

13. Please list two things that **mangrove** plants need to survive:

      a. _____

      b. _____

14. How do **mangrove** animals get what they need to survive?

15. Please list one way that **mangroves** are the SAME as the place where you live?

      a. _____

16. If you could learn more about deserts or mangroves, what else would you like to know?

STOP!

DO NOT remove the staple.

Please give the packet to your afterschool leader.

Part 2

1. Are you interested in exploring nature? (Circle one)

    a. Yes

    b. No

    c. I don't know

2. Do you like to go outside to try to learn more about nature? (Circle one)

    a. Yes

    b. No

    c. I don't know

3. Did Plum Landing make you want to go outside more? (Circle one)

    a. Yes

    b. No

    c. I don't know

4. Please list two things that are special about **the desert**:

    a. _____

    b. _____

5. Please name two animals or plants that live in **the desert**:

    a. _____

    b. _____

6. Please list two things that **desert** plants need to survive:

   a.   _____

   b.   _____

7. How do **desert** animals get what they need to survive?

8. Please list one way that **the desert** is the SAME as the place where you live:

   a.   _____

9. Please list two things that are special about **mangroves**:

   a.   _____

   b.   _____

10. Please name two animals or plants that live in **mangroves**:

    a.   _____

    b.   _____

11. Please list two things that **mangrove** plants need to survive:

    a.   _____

    b.   _____

12. How do **mangrove** animals get what they need to survive?

13. Please list one way that **mangroves** are the SAME as the place where you live?

    a. _____

14. If you could learn more about deserts or mangroves, what else would you like to know?

15. What more would you like to see Plum and the kids explore in future episodes?

16. Did you discover anything new from Plum? If yes, please tell us about what you learned.

Thank you! Please return this survey to your afterschool leader.

*1. First name

*2. Last name

*3. Program name

*4. City and State:

5. Are there barriers to getting outdoors with kids in your program? If so, what are they?

6. How comfortable are you using a digital educational resources or digital media resources in your program?

- ○ Very comfortable
- ○ Comfortable
- ○ Neutral
- ○ Slightly uncomfortable
- ○ Very uncomfortable

7. Please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
I am comfortable exploring nature with the kids in my program.	○	○	○	○	○	○
I am interested in exploring nature with the kids in my program.	○	○	○	○	○	○
I enjoy exploring nature with the kids in my program.	○	○	○	○	○	○
I think it's important to support the kids' interest in nature.	○	○	○	○	○	○
I know how to support the kid's interest in exploring nature.	○	○	○	○	○	○
I know how to help kids come up with interesting questions about how things work in nature.	○	○	○	○	○	○
When the kids in our program play outside, it's important to me that they explore nature (such as looking for worms or drawing birds).	○	○	○	○	○	○

8. Please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I Don't Know
The kids in our program are interested in learning about nature.	○	○	○	○	○	○
The kids in our program are motivated to go outside and explore nature.	○	○	○	○	○	○
The kids in our program ask interesting questions about how things work in nature.	○	○	○	○	○	○

Afterschool Survey for Educators - Control Group Post-Test

*1. First name

*2. Last name

*3. Program name

*4. City and State:

5. Please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
I am comfortable exploring nature with the kids in my program.	○	○	○	○	○	○
I am interested in exploring nature with the kids in my program.	○	○	○	○	○	○
I enjoy exploring nature with the kids in my program.	○	○	○	○	○	○
I think it's important to support the kids' interest in nature.	○	○	○	○	○	○
I know how to support the kid's interest in exploring nature.	○	○	○	○	○	○
I know how to help kids come up with interesting questions about how things work in nature.	○	○	○	○	○	○
When the kids in our program play outside, it's important to me that they explore nature (such as looking for worms or drawing birds).	○	○	○	○	○	○

Afterschool Survey for Educators - Treatment Group Pre-Test

*1. First name

*2. Last name

*3. Program name

*4. City and State:

5. What are the ages of the kids who will be in the Field Test? (Choose all that apply)

- ☐ 7
- ☐ 8
- ☐ 9
- ☐ Younger than 7
- ☐ Older than 9

6. How many kids will be in the Field Test?

7. Have you ever had any experience trying to incorporate hands-on science or environmental activities into your afterschool program? If so, please briefly tell us about it.

8. Are there barriers to getting outdoors with kids in your program? If so, what are they?

9. How comfortable are you using a digital educational resources or digital media resources in your program?

◯ Very comfortable

◯ Comfortable

◯ Neutral

◯ Slightly uncomfortable

◯ Very uncomfortable

10. Please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
I am comfortable exploring nature with the kids in my program.	◯	◯	◯	◯	◯	◯
I am interested in exploring nature with the kids in my program.	◯	◯	◯	◯	◯	◯
I enjoy exploring nature with the kids in my program.	◯	◯	◯	◯	◯	◯
I think it's important to support the kids' interest in nature.	◯	◯	◯	◯	◯	◯
I know how to support the kid's interest in exploring nature.	◯	◯	◯	◯	◯	◯
I know how to help kids come up with interesting questions about how things work in nature.	◯	◯	◯	◯	◯	◯
When the kids in our program play outside, it's important to me that they explore nature (such as looking for worms or drawing birds).	◯	◯	◯	◯	◯	◯

11. Please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I Don't Know
The kids in our program are interested in learning about nature.	◯	◯	◯	◯	◯	◯
The kids in our program are motivated to go outside and explore nature.	◯	◯	◯	◯	◯	◯
The kids in our program ask interesting questions about how things work in nature.	◯	◯	◯	◯	◯	◯

Afterschool Survey for Educators - Treatment Group Post-Test

*1. First name

*2. Last name

*3. Program name

*4. City and State:

5. How many kids were in the Field Test?

*6. Which of the Club Pathways were you able to try?

○ Operation Evaporation (about deserts) only

○ Water in your World (about mangroves) only

○ Both

7. Did you have to skip any activities or make any modifications to the Pathways? If so, please describe.

8. Did you have any challenges showing the online videos to your kids? If so, please describe how you handled the problems.

9. Did you have any challenges doing activities with the kids outside? If so, please describe how you handled the problems.

10. Did you TAKE any photos using the Photo App? If so, how many?

◯ None

◯ 1-2

◯ 3-5

◯ More than 5

11. Did you UPLOAD any photos using the Photo App? If so, how many?

◯ None

◯ 1-2

◯ 3-5

◯ More than 5

12. Do you have photos that you can share with us for our report?

◯ Yes

◯ No

13. Please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
I am comfortable exploring nature with the kids in my program.	◯	◯	◯	◯	◯	◯
I am interested in exploring nature with the kids in my program.	◯	◯	◯	◯	◯	◯
I enjoy exploring nature with the kids in my program.	◯	◯	◯	◯	◯	◯
I think it's important to support the kids' interest in nature.	◯	◯	◯	◯	◯	◯
I know how to support the kid's interest in exploring nature.	◯	◯	◯	◯	◯	◯
I know how to help kids come up with interesting questions about how things work in nature.	◯	◯	◯	◯	◯	◯
When the kids in our program play outside, it's important to me that they explore nature (such as looking for worms or drawing birds).	◯	◯	◯	◯	◯	◯

14. Please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	I Don't Know
The kids in our program are interested in learning about nature.	○	○	○	○	○	○
The kids in our program are motivated to go outside and explore nature.	○	○	○	○	○	○
The kids in our program ask interesting questions about how things work in nature.	○	○	○	○	○	○

15. Please tell us how much you agree or disagree with the following sentences.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
Plum Landing made our kids more interested in learning about nature.	○	○	○	○	○	○
Plum Landing helped motivate our kids to go outside and explore nature.	○	○	○	○	○	○
Plum Landing helped our kids ask interesting and appropriate questions about how things work in nature.	○	○	○	○	○	○
The kids in our program learned about nature from Plum Landing.	○	○	○	○	○	○
Our kids were able to think about how the place where we live is similar to and different from a desert or a mangrove.	○	○	○	○	○	○
Our kids used the Nature Sketchpad, and/or the photo app to make observations about nature.	○	○	○	○	○	○

16. What do you like BEST about Plum Landing?

17. What do you like LEAST about Plum Landing?

18. Will you continue doing Plum Landing activities with kids in your program? Please explain.

19. What did you think about the descriptions of the pathways? Would you suggest more or less context or explanation for what the pathway is about? What could we have provided to help you get started?

20. What was it like for you navigating through the pathways (I.e., was it obvious that when you came to the end of one resource, you need to navigate back to the pathway page? Or, were you expecting some kind of a "next" button to take you to the next item in the pathway?).

21. Please comment on the background on the science content in the pathways--Would you like more or less? Please explain.

Appendix C: Coding Strategies and Open Response Categories

Question: [Family Survey] Please list three things that are special about the desert. [Student Survey] Please list two things that are special about the desert (or mangroves).

For each subpart of the question, responses were given either a zero, one, two, or O for opinion. Coding was determined based on the quality of content for each response. Codes were given based on emergent responses.

Zero

Zeroes were given to answers that either did not relate to the question, were completely wrong, or unclear. Answers that stated opinions were also given a zero. These types of responses incorporated facts, but were neither true nor false based on the language used in the answer.

Family Survey Examples

- Fun
- Color
- It's a good place to be warm if you're cold
- Pretty
- No rain
- No noise

- Not a lot of animals are there because there's not much food there
- That there's no dirt
- It does not have very many animals
- The grand canyon

Student Survey Examples

- ?
- what They are
- don't know what mangrove is
- mountain
- I think its tree grove

- smell
- colors
- and taste good.
- smell good

Note that throughout the Appendix, we have not corrected student responses. We have included them just as students wrote them.

One

General responses that covered a wide range of subject matter were given a one. Single word answers (though there are also one word answers which were given a two) that did not go into detail were given a one. Many single word answers were correct but did not go into the same detail as other multi-word responses.

- Hot
- Animals
- Sun

- Deserts are hot
- Heat!
- All sand

Student Survey Examples

- Water
- lots of tree
- safe hiding

- they touch water
- clean water
- it has sun

Two

Responses that showed deeper knowledge, went into greater detail, and revealed more sophisticated vocabulary were given a two. Answers that clearly reflected content talked about by Plum Landing were given a two.

Family Survey Examples

- It gets really cold there at night
- Snake
- They are covered in sand
- It's not dead
- It gets really hot

- Big wide open land
- The plants in the desert have long roots to get water from deep down
- Oyasis
- Adapt

Student Survey Examples

- they get water from the ocen
- The roots grow under water.

- it is a day care to fish
- Animals live in them

Question: [Family Survey] Please name three animals or plants that live in the desert. [Student Survey] Please name two animals or plants that live in the desert (or in mangroves).

Responses were given a zero, one, or two for each subpart of the question.

Zero

Responses that either required a guess to determine what the individual was trying to write or were completely wrong were given a score of zero.

Family Survey Examples

- EVERYTHING
- OK

- KOOL
- do

- ?
- Roadrunners

- what is a mangrove?
- cactuses

One

Responses which received a score of one mentioned broad categories of a particular animal. Since all answers were compared to each other for scoring, if there was a child who mentioned a certain kind of spider like tarantula, or a type of snake like cobra, the response snake and spider would then warrant a score of one.

Family Survey Examples

- Snake
- Spider
- Scorpion

- Birds
- Owl
- Trees

Student Survey Examples

- fish
- birds

- lizard
- insects

Two

Responses which received a score of two pointed out specific kinds of snakes, lizards, birds, trees, or other broad categories of animals.

Family Survey Examples

- Burling owl
- Cobra
- Toad
- Camel
- Cactus

- Suwaro woodpecker
- Thorny devil
- beetles
- Armadillo
- Fox

Student Survey Examples

- Sharks
- manatees
- alligators

- shrimp
- Western Indian manatee
- catfish

Question: [Family Survey] Please list three things that desert animals and plants need to survive. [Student Survey] Please list two things that desert (or mangrove) plants need to survive.

For each subpart, responses were coded based on a score of zero, one, or two.

Zero

Responses which received a score of zero answered the question incorrectly or responded with an unclear or unrelated answer.

Family Survey Examples

- holes
- EVERYTHING
- stay alive

- people
- vegetables
- soy

Student Survey Examples

- ?
- mathoren
- sathen.

- what is mangrove?
- shelter
- skip

One

Answers that were coded as a one used less sophisticated language than answers coded as a two. The answer may not have been vital for the life of every plant or animal, though a plant or animal may have indirectly relied on it for survival. *The term sleep was given a one because some scientists are still hesitant to attribute the term sleep to certain animals (reference from http://www.bbc.com/future/story/20130927-do-all-animals-need-sleep).*

Family Survey Examples

- Sleep
- Bug
- Camel
- Other animals

- iguana
- birds
- prey
- home

Student Survey Example

- shelter

Two

Responses which used accurate and sophisticated language or were necessities for survival for either plants or animals were given a two.

Family Survey Examples

- photosynthesis
- water
- sun
- food

- oxygen
- rain
- sun
- sunlight

- sun
- water

- sunlight
- They need food

Question: [Family Survey] How do desert animals and plants get what they need to survive? [Student Survey] How do desert (or mangrove) animals get what they need to survive?

Responses were coded based on a score of zero, one, or two.

Zero

Due to the wording of the question, any response which started off with "from" was given a zero because the individual did not describe how an animal gets what it needs to survive. Other responses which were given a zero were completely incorrect or partially incorrect. Answers which were only partially incorrect but marked as zero had incorrect parts of the response which outweighed the correct response.

Family Survey Examples

- They have to go look for it under the dirt and under the trees and sometimes people help them
- From rain, and when the sun comes out

- i don't know
- rain
- frome peple thta com breeng it too thum
- from nature
- skill

Student Survey Examples

- ?
- go along distances from where they are.

- food water
- finding oases

One

Responses which used basic language to describe how animals and plants survive were given a one. If there was an answer which was partially correct, but a part of the response was unclear, it received a one.

Family Survey Examples

- they store it and use it slow
- from the earth and other animals that they eat
- They have to find food and water

- Animals find food to survive
- eat food drink water
- They hunt,rain,move, and reach
- They search for it and eat it

- they find their prey
- They find it in the mangrove swamps.
- drink water

- try to find it
- mangrove animals get water by getting sips from the shore.

Two

Responses which were given a two had sophisticated and scientific language or were complex, detailed descriptions of how animals and plants get what they need to survive. Responses might have had only one word but if the word was descriptive and advanced compared to other responses, it was given a score of two. Answers that mentioned specific plants or animals were also given a two. Some partial credit answers received a two based on the language used and level of detail in the response.

Family Survey Examples

- They look for the water under the dirt and in the trees and plants, and look for shade. And maybe they hunt for their food
- they hunt for it
- ADAPTATION - LIKE CAMELS STORE UP THEIR WATER BECAUSE THEY DON'T KNOW WHEN IT WILL RAIN AGAIN
- They get water because their roots are very very deep. Animals wait for the rain or sometimes animals dig caves or burrows to keep from burning up in the heat.
- Animals fight to get their food, shade for protection. Plants store water
- Bilbys dig holes in the ground to get shelter. Dingos go to water holes to get their food and water. Plants depend on the rain and have long roots so they can store water in their roots. It's moist at the bottom of the soil so the roots get water that way.
- They can store water for a long time
- Hunt and wait for water

Student Survey Examples

- lots of shelter
- they go hunt
- by adapting
- hiding in roots

- monkeys get food by climbing to it in trees
- They can hide from the predators that come.

Please list one way that the desert (or mangroves) is the SAME as the place where you live.

Please list one way that the desert (or mangroves) is the DIFFERENT from the place where you live.

Responses in both questions were given either a zero, one, two, or three. Contrary to how other questions were scored, a three was added here to account for responses which were nearly 100% correct but did not distinguish between hot and cold deserts or varying temperature in the same desert. Answers that were descriptive, accurate, and detailed were given a three and set the precedent for responses with scores of zero, one, and two.

Zero

Answers which stated that the desert was always a specific temperature were marked as zero. If we needed to guess in order to categorize a particular response they were scored as zero. This includes responses where children answered question 14 as if they were answering question 15 and vice versa.

Family Survey Examples

- it's very warm
- no rain
- humid
- BECAUSE IT'S INSIDE
- it has different plants and animals - Response to Question 14

- it has land, not very sure
- it is the same air the same water - although a little less the same sunlight the same god almighty created it and us all
- got water

Student Survey Examples

- ?
- life cycle of the desert
- Streets

- don't know what mangrove is
- hills
- we have

One

Responses which less clear, mostly correct, and did not provide much information received a one. Answers that were weak and not fully articulated and statements that did not take into consideration that some deserts are hot and some are cold received one's as well. Answers that were partially right but included information that was incorrect when compared to where the respondent lived received a one.

Family Survey Examples

- hot all the time

- in the summer it's hot

- it gets real hot sometimes where I live
- "It's hot and dry in the south - Respondent was from Georgia
- has too much sand

- sand
- It is cold here in the winter
- The sun
- We have no sand
- plants
- It's hot

Student Survey Examples

- Hot
- trees
- leaves

- Grass
- they are not very dry
- wet

Two

Answers that were fully thought out and correct based on the respondent's home state, but assumed that all deserts were hot, received a two. Answers that referred to extreme desert temperature without acknowledging that different deserts have different temperatures were also given a two.

Family Survey Examples

- The desert is SUPER hot
- It's very, very hot
- It is very hot - Respondent is from Texas
- Desert has cactus and we have it in our home

- Where I live there is lots of living things like green trees because there is enough water
- Lots of sand
- it is very dry

Student Survey Examples

- sunny
- its rainy

- there's water
- in summer it is hot

Three

Responses that accurately applied to all deserts and were correct comparisons between a desert and the respondent's home state were given a three. Responses that acknowledged deserts could be hot or cold and change temperature between daytime and nighttime were given a three. Responses that included scientific language were also given three's.

Family Survey Examples

- Our place and their place both have oxygen and carbon dioxide
- I see snakes sometimes where I live

- We both have plants and animals, trees, and snakes, spiders, lizards, and birds
- It has Sun in the day and gets cold at night" it has special animals and plants that are rare here

- The desert has harsh temperatures all of the time
- there are sand dunes and no or very less rains in deserts , we have plenty

- There are plants and trees in the desert... There are plants and trees here too!
- the weather temperatures vary just like the desert

Student Survey Examples

- there are animals
- it's a habitat for a animals.
- mangroves are a type of tree and we have trees where we live.
- because we bolth have rivers and streams.
- My house is protective.
- they get sunlight like nomal plant and water.

Open Response Categories

Categories were first broken down into the general subject matter of the response. A slash would indicate a subcategory and an underscore would highlight a question that delved deeper into content or specify the type of question. Multiple slashes define new subcategories of an overarching topic. A dash indicates a new overarching category in responses which covered several topics.

Categories emerged throughout the coding process. Answers were coded independent of their score so as to have an understanding of what content topics students were thinking about. An example of categories can be found below.

Unclear/geography_land Unclear/inside_because it's Unclear/geography_mountains	Relationship/plants animals help each	Sky/dark_at night- Sky/sun_everyday/dark_at night Sky/sun/dark_at night Sky/sun_sunrise/sunset_dark _at night
Seasonally based/summer_temperature_hot Seasonally based/summer_temperature_hot	Temperature/night and day_hot during the day cool at night Temperature/hot_real hot where I live Temperature/hot_really hot where	Abiotic/sand_more than grass- Abiotic/sand_covered in Abiotic/sand_more Abiotic/sand_lots of_there
Animals/all_dangerous/bugs_dangerous Animals/reptiles Animals/birds/all_on ground Animals_it has Animals/snakes_we have Animals/it has Animals/snakes/lizards_has Animals_there are Animals/habitat_all have	Modern structures/cars_less in desert/buildings_less in desert- Modern structures/houses_none	Plants Plants_we have- Plants_many- Plants/cactus- Plants_there are/own ecosystem- Plants/own habitat-
Answered as Q15	Area type/urban_more where i live-	Desert_we have none
Precipitation/rain_not a lot Precipitation/rain_little- Precipitation/rain_less	Geography/mountains/plains	Statement/play with_nobody to Statement/personal/live in desert
General desert features/has life		