



Watershed AquaBlitz

A Watershed Ecology Education Module



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The Cache la Poudre AquaBlitz

Three science programs from two schools participated in the one-day AquaBlitz at two sites during the first week of May 2015. Approximately 175 students from 4th, 5th and 8th grade attended three disparate events. Over the course of each morning smaller groups of students rotated through three stations: Water Quality, Stream Assessment and Local Watershed History, though stations could be conducted consecutively with a small group of students. Curriculum from these stations, and a follow-up data lesson, were incorporated this lesson booklet that can be utilized for future watershed ecology education. The purpose of this environmental education project was to conduct and test the efficacy of a watershed ecology module with 4th-8th grade students, focusing on the Cache la Poudre basin and its biophysical and socio-cultural connections.

The project was envisioned as a rapid assessment Blitz style project to assess watershed health with students. The name BioBlitz, or biodiversity blitz, derives from rapid biodiversity assessment events combined with public outreach and provide a snapshot of current biodiversity. While no overarching protocol exists for Blitz events, generally events focus on identifying as many species as possible, both flora and fauna, during a pre-determined time frame. The AquaBlitz, however, was designed to provide curricula focusing on watershed ecology and incorporate a rapid assessment of watershed health over the course of a week with elementary school students.

Specific objectives were designed to be addressed by the curricula:

1. Provide hands-on environmental education learning opportunities for students with ecological and local foci, incorporating watershed and stream ecology, water quality and chemistry, history and human impacts, and connectivity between these components.
2. Provide a set of lesson plans consistent with Colorado State educational standards, usable across the Cache la Poudre watershed and Colorado Front Range, for testing water quality, completing stream health assessments, exploring the watershed concept, and simultaneously investigating the history of water use in the watershed.
3. Work with students to capture the elevational, watershed-wide, variation in water quality and stream health.
4. Utilize and introduce schools and students to technology in science, specifically that associated with typical water quality and stream assessment field-testing procedures and utilization of online databases.

It is my hope that these lessons will provide a template for future watershed ecology units for Colorado Front Range students. Project results and data analysis can be accessed at the Colorado State University Digital Repository at the Library website <https://dspace.library.colostate.edu/handle/10217/100532>. The story map and other digital materials can be accessed through the QR Code below or at <http://csurams.maps.arcgis.com/apps/MapJournal/?appid=48404a1ce89246d1b1b49c1f5df322e3>.

This project would not have been a success with out the help of various people and organizations, including funding provided by the Poudre Heritage Alliance. Special thanks to: Kathleen Benedict, the Poudre Heritage Alliance; Joe Kilpatrick; Laura Istel; Cook St. Productions; the City of Fort Collins WaterSHED; the Poudre School District and participating schools and teachers; Sophia Linn, Geospatial Centroid, CSU; the Poudre Learning Center; Andrew Warnock, Education and Outreach Center, CSU, Meena Balgopal, Department of Education, CSU; Hanna Industries; and the graduate degree committee.



Streams & Rivers

- Streams and rivers are the surface pathways from which water travels through the watershed.
- Streams and rivers are located in valleys, and are often good places for human settlements.
- Streams and rivers are important habitat for aquatic plants and animals.
- Water in streams and rivers is important for human uses like recreation, drinking water and irrigation.

Uplands & Mountains

- These areas are important for snow storage and provide runoff into streams and rivers.
- The geology of these areas sets the baseline chemistry of streams.
- Important habitat areas for some animals like bear and elk.
- Mountains set the boundary of the drainage area of watersheds.
- Groundwater recharge occurs throughout the watershed, including upland areas.

Riparian Areas

- Riparian areas are a boundary where groundwater and surface water interact, during dry months groundwater flows into the rivers and in wetter months river water flows into aquifers.
- Riparian areas are the areas right next to streams and rivers.
- Riparian areas provide habitat to rare plants and animals and act as travel corridors for many species.
- The vegetation and landscapes near the rivers provide flood control.
- These are also popular areas for recreation, where many parks are located.

Groundwater

- Groundwater is water that is stored in aquifers.
- This water is important as a buffer from droughts and helps streams flow all year long.
- As water travels through the rocks and geology underground it is cleaned and purified.
- Drinking water sometimes comes from groundwater sources.

Water Quality

During this lesson students will complete water quality tests on site and learn about variation in water quality parameters. This lesson utilizes Hanna Industries Backpack Labs and is written about ranges of Colorado Front Range parameters, some modifications will be necessary with alternate equipment or in alternate locations.



Title: Water Quality		Time: 60 minutes
Facilitators:		Materials: <ul style="list-style-type: none"> • Water quality testing equipment (Backpack Labs) • Data sheets • Stopwatch • Buckets or small containers • Clipboards • Calculator • Safety equipment & sanitizing wipes • Preprinted activity statements • Card tables
Purpose: The participants are expected to have a better understanding of water quality in rivers and streams, how these parameters might be different throughout the watershed, and how water quality can be affected by addition of pollutants.		
Learning Objectives: By the end of this session, participants will be able to: <ul style="list-style-type: none"> • Record the range of water quality parameters and understand the implications of each parameter for the Cache la Poudre watershed through completion of water quality testing activities. • Demonstrate correct use of the water quality testing equipment to analyze stream water through correct completion of data sheets. • Discuss the importance of water quality for plant and animal life and how it can be changed via either natural or human causes. 		
Prep Work		
<ul style="list-style-type: none"> • Set up one card table station per group of students. Arrange only the tests needed. • Fill a bucket of water for rinsing vials. Do not use this water for conducting tests. • Before the activity begins the facilitator should run all of the tests and record the results for comparison with student results. 		
Procedures		
Minutes	Lead Facilitator	Activities
5		Introduction/Break into Groups (5-6 students) <ul style="list-style-type: none"> • What is the difference between water chemistry and water quality? <ul style="list-style-type: none"> • Students will be shown preprinted cards with statements on them and asked decide the definitions of water quality and water chemistry. • Facilitators will guide students to the correct answers and help students understand the difference between the two.
5		Safety Talk <ul style="list-style-type: none"> • Be careful with chemicals; don't dump samples back into river dump them on to a rocky or sandy area away from the stream. • Fill out data sheets carefully; the data will be uploaded later.

40		<p>Water Testing & Data Recording</p> <ul style="list-style-type: none"> Organize tests and instruction sheets in order: <ol style="list-style-type: none"> Dissolved Oxygen (started by facilitator) Temperature/pH Carbon Dioxide Nitrate & Phosphate Have student volunteers fill two buckets (or two yogurt containers per group) with stream water, one for rinsing testing containers and one for taking samples. Pre-rinse both buckets before filling to prevent contamination of samples. Students will follow the guidelines for testing the various parameters according to the laminated Backpack Lab instruction sheets, while facilitators discuss the importance of the parameters and assist if needed. Begin with the first part of the Dissolved Oxygen test to be completed by facilitator as an example (through addition of Reagent 3, until particulate is dissolved), set aside and distribute enough sample to each group to complete the Dissolved Oxygen test after the Carbon Dioxide test. <ul style="list-style-type: none"> Students will likely not understand all of the vocabulary on the instruction sheets, be prepared to explain. At the beginning and end of each test students will rinse equipment. <p>Potential Activity Modifications:</p> <ul style="list-style-type: none"> If snow is still present, possibly have one student group conduct measurements on melted snow for comparison to stream water. If weather is bad, omit temperature measurements and bring water samples to the classroom.
10		<p>Group Discussion</p> <ul style="list-style-type: none"> What might change the results from the tests? <ul style="list-style-type: none"> Assessment/Inquiry: How water chemistry might differ throughout the watershed? Assessment/Inquiry: How might some parameters change on site and how does this affect water quality? <p>Optional Activity: change the pH of stream water as an example.</p> <ul style="list-style-type: none"> Each group of students will be given a new sample. The pre-mixed samples will each have a different amount of orange juice mixed with water. Students will be asked to describe the samples. What do the samples look like? How are they different from group to group? Students will retest the pH of the polluted samples and be asked to get into order from smallest to highest pH number. <ul style="list-style-type: none"> Assessment/Inquiry: How can a change in water quality affect wildlife?

State Standards:

- There is interaction and interdependence between and among living and nonliving components of systems (Science 2.3, 4th grade).
- Use several types of geographic tools to answer questions about the geography of Colorado (Social Studies 2.1, 4th grade).
- Connections within and across human and physical systems are developed (Social Studies 2.2, 4th grade).
- Earth's surface changes constantly through a variety of processes and forces (Science 3.2, 5th grade).
- Causes and consequences of movement (Social Studies 2.2, 5th grade).
- Changes in environmental conditions can affect the survival of individual organisms, populations, and entire species (Science 2.1, 6th grade).
- Water on Earth is distributed and circulated through oceans, glaciers, rivers, ground water, and the atmosphere (Science 3.2, 6th grade.)
- Earth's natural resources provide the foundation for human society's physical needs. Many natural resources are nonrenewable on human timescales, while others can be renewed or recycled (Science 3.3, 6th grade).
- Use geographic tools to solve problems (Social Studies 2.1, 6th grade).
- Human and physical systems vary and interact (Social Studies 2.2, 6th grade).

Dissolved Oxygen

- Aquatic animals breathe in oxygen, without enough oxygen the water can become toxic to animals.
- When water is turbulent, or has lots of waves, like in mountain streams, it picks up oxygen from the air.
- When there are lots of plants you can expect more oxygen because of photosynthesis. At night plants produce less oxygen.
- The temperature of the water affects how much oxygen the water can hold. Cold water can hold more oxygen than warm water.
 - **Assessment/Inquiry:** Where in the watershed do you think will have high levels of dissolved oxygen? What place might have low levels?
- Higher levels of dissolved oxygen in drinking water makes it taste better.
- The ideal dissolved oxygen concentration for many fish is between 7 and 9 mg/l. Most fish cannot survive at concentrations below 3 mg/l of dissolved oxygen. Colorado Department of Public Health and Environment Water Quality Control Division regulations state that waters used for recreation (both primary and secondary contact) should not have DO concentrations below 3 milligrams per liter (mg/l).

Temperature

- Some plants and animals can only survive at certain temperatures, if the water is too warm or too cold they will not be able to live.
- Temperature will change throughout the watershed and throughout the day and throughout the year.
 - **Assessment/Inquiry:** What could change the temperature of the water here?
- Water temperature affects the amount of oxygen in the water, warm water holds less oxygen and can make it difficult for animals to survive.
- Colorado Department of Public Health and Environment-Water Quality Control Division (CDPHE-WQCD) regulations (5 CCR 1002-31) state that waters classified as “Class 1 Cold Water Aquatic Life” should never have temperatures exceeding 20° C, while waters classified as “Class 1 Warm Water Aquatic Life” should never have temperatures exceeding 30° C (<http://www.cdphe.state.co.us/cdphereg.asp#wqreg>).

pH

- pH is a measurement of how acidic or basic the water is. The scale ranges from 0 to 14. Zero is completely acidic and 14 is completely basic. Milk has a neutral pH 7 and drinking water is usually close to 7 also. Rainwater has a pH of 5.6.
- Most plants and animals can survive a range of values but if the water becomes too acidic or basic their shells, skin or leaves will be destroyed.
- The pH of river and stream water can change because of pollution or during storms when lots of water is flowing into the streams.
- Most stream water in this area should have a pH between 6-8.
- Very high (greater than 9.5) or very low (less than 4.5) pH values are unsuitable for most aquatic organisms.
- Colorado Department of Public Health and Environment Water Quality Control Division regulations state that waters used for primary recreation (including such activities as swimming, rafting, and kayaking) should have pH values between 6.5 and 9.0.
- Colorado Department of Public Health and Environment Water Quality Control Division regulations state that waters classified as “Class 1 Cold Water Aquatic Life” or “Class 1 Warm Water Aquatic Life” should have pH values between 6.5 and 9.0.

Carbon Dioxide

- Carbon dioxide is important for aquatic plants, which consume carbon dioxide and produce oxygen for use by aquatic animals.
- Too much carbon dioxide is usually produced by large amounts of dead or dying plants and animals.
- Lakes and rivers usually contain less than 10 mg/L of carbon dioxide but water that is polluted or stagnant can have much larger amounts.

Stream Assessment

The stream assessment lesson introduces students to the geographic concept of a watershed, and connectivity of water throughout the watershed as it flows from upland areas through groundwater, streams and their riparian areas. Students will learn about assessing the health of a stream as part of learning about overall watershed health. This lesson is written specifically for the Cache la Poudre and other Colorado Front Range watersheds but is applicable to other snow-fed systems with minimal modifications.



Title: Stream Assessment		Time: 60 minutes
Facilitators:		Materials: <ul style="list-style-type: none"> • Data sheets • Pin flags • One clipboard per group • Extra paper • Notebook and pencil for each student
Purpose: The participants will be exposed to a stream ecosystem, learn about stream habitat, understand where the study site fits into the watershed and gain understanding about connectivity of water within the watershed.		
Learning Objectives: By the end of this session, participants will be able to: <ul style="list-style-type: none"> • Distinguish characteristics of different watershed landforms and water transport mechanisms through group identification and discussion of four components of a watershed. • Identify basic stream components, assess the level of naturalness and stream health and record them on a data sheet. • Understand the larger context of the stream site within the watershed, and the watershed in context to the continent; they will be able to identify the major river in the watershed and which ocean it ultimately flows into. 		
Prep Work		
<ul style="list-style-type: none"> • Demarcate one section of the stream for each group to assess. If sufficient length is not accessible, mark only one section. Try and incorporate enough length and variation so that students gain an appropriate idea of stream health. • Know the location of the headwaters of the stream on site and the path the water takes on its way to the ocean. 		
Procedures		
Minutes	Lead Facilitator	Activities
10		Introduction <ul style="list-style-type: none"> • Discuss four components of a watershed. Encourage students to name different components. (Streams and rivers, uplands and mountains, riparian areas, groundwater). • Describe to students how water is connected through each of the components. • Discuss with students the path of water through the watershed, into the next largest river and eventually the ocean. Emphasize that different watersheds may ultimately end in a different ocean. Possible indoor activity: Break into four groups and with the help of a facilitator draw or list, on a large sheet of paper, the different components and share with the group at large.

10		<p>Activity Overview</p> <ul style="list-style-type: none"> • Safety discussion and group formation (5-6 students per group) <ul style="list-style-type: none"> • Students will listen to a short talk on safety and break into per-determined groups for the stream assessment activity. • Briefly discuss leave no trace ethics. • Students will listen to a description of the data sheets and define the two portions of the assessment: Habitat and Hydrology. <ul style="list-style-type: none"> • Briefly brainstorm how habitat and hydrology might be important for stream health.
30		<p>Stream Assessment & Data Recording</p> <ul style="list-style-type: none"> • In their small groups, students will fill in the data sheets (one per student if possible) for per-determined lengths of stream. The data can later be uploaded and compared to other schools' assessments throughout the watershed. <p>Optional Activity: Students can complete a cross-section diagram detailing what may be affecting the stream from the surrounding landscape and/or complete photo records of their reach.</p>
10		<p>Group Discussion & Lesson Assessment</p> <ul style="list-style-type: none"> • Ask students for examples of good or poor habitat and hydrology that they saw during their assessment. • Assessment/Inquiry: What in the surrounding landscape is affecting the stream? • Assessment/Inquiry: What do you think about the health of the stream for wildlife? For humans? • At the end of the session ask the students to re-list the components of the watershed, describe the path that water takes as it flows through the watershed, and define key terms. <p>Optional Activities: Have small groups of students answer these pre-written questions on index cards or have students pair up to answer questions and ask volunteers to share what their partner said.</p>

State Standards:

- All living things share similar characteristics, but they also have differences that can be described and classified (Science 2.1, 4th grade).
- There is interaction and interdependence between and among living and nonliving components of systems (Science 2.3, 4th grade).
- Use several types of geographic tools to answer questions about the geography of Colorado (Social Studies 2.1, 4th grade).
- Connections within and across human and physical systems are developed (Social Studies 2.2, 4th grade).
- Earth's surface changes constantly through a variety of processes and forces (Science 3.2, 5th grade).
- Weather conditions change because of the uneven heating of Earth's surface by the Sun's energy. Weather changes are measured by differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation. (Science 3.3, 5th grade).
- Use various geographic tools and sources to answer questions about the geography of the United States (Social Studies 2.1, 5th grade).
- Causes and consequences of movement (Social Studies 2.2, 5th grade).
- Changes in environmental conditions can affect the survival of individual organisms, populations and entire species (Science 2.1, 6th grade).
- Organisms interact with each other and their environment in various ways that create a flow of energy and cycling of matter in an ecosystem (Science 2.2, 6th grade).
- Complex interrelationships exist between Earth's structure and natural process that over time are both constructive and destructive (Science 3.1, 6th grade).
- Water on Earth is distributed and circulated through oceans, glaciers, rivers, groundwater, and the atmosphere (Science 3.2, 6th grade).
- Earth's natural resources provide the foundation for human society's physical needs. Many natural resources are nonrenewable on human timescales, while others can be renewed or recycled (Science 3.3, 6th grade).
- Use geographic tools to solve problems (Social Studies 2.1, 6th grade).
- Human and physical systems vary and interact (Social Studies 2.2, 6th grade).

Nitrates

- Nitrate is one form of nitrogen that is found in water.
- Plants use nitrogen to build their structures and take up nitrogen through their roots.
- Most nitrates are formed in water from rainfall, decomposition of organic matter and through runoff from man-made pollution.
- Large amounts of nitrate can lead to heavy growth of plant life. Overgrown plant life can block the ability of sunlight to lower water levels and deplete oxygen levels causing unhealthy ecosystems.
- Nitrates commonly come from fertilizers and lawn maintenance.
- Too much nitrate is harmful to humans. Drinking water has a limit of no more than 10mg/L.

Phosphates

- Phosphates are formed from the element phosphate and encourage growth of aquatic plants.
- If lots of phosphate is added to water excessive growth occurs it can affect oxygen and carbon dioxide levels and reduce water quality.
- Phosphates commonly come from fertilizers, soaps and detergents. Phosphates are only dangerous to animals or humans in very high levels.
- Many places do not have regulations on phosphates.

Local History

During the history lesson students will learn about the history specifically related to water use in the watershed. This lesson is specifically written for the Cache la Poudre watershed and is unique to the area. Supplemental material would need to be entirely re-written to accommodate the local history of the watershed where the activities are being completed.



Title: Local History		Time: 60 minutes
Facilitators:		Materials: <ul style="list-style-type: none"> • Story sheets • Scavenger hunt story boards or item list
Purpose: Students will be exposed to history of the watershed with a focus on how streams and rivers have been used or changed by humans.		
Learning Objectives: By the end of this session, participants will be able to: <ul style="list-style-type: none"> • Be exposed to local historical information regarding water use in the Cache la Poudre basin by reading short stories and sharing what they learn with their classmates. • Recognize how humans have used streams and rivers in the Cache la Poudre watershed over time by representing common historical use creatively by sharing their scavenger hunt discoveries amongst themselves. 		
Prep Work		
<ul style="list-style-type: none"> • If insufficient historical items can be found on site, create representative historic items for the students to complete their story boards. • Before the students arrive, either hide the pre-made scavenger hunt items or determine the on-site items to be collected by the students for their stories. 		
Procedures		
Minutes	Lead Facilitator	Activities
15		Introduction/Break into Groups (5-6 students) <ul style="list-style-type: none"> • Each of five groups (Native American, The First Europeans, Early Settlers, Towns and Farms, Cities and Recreation) will be given a color-coded story sheet to read over. <ul style="list-style-type: none"> • Each group of students will be assigned one historical time frame to read over individually and then discuss in a small group. Ask a volunteer to read aloud each time frame, in order, to the larger group.
20		Scavenger Hunt <ul style="list-style-type: none"> • Groups will find items that may have been important to wildlife or humans during their historical period. <ul style="list-style-type: none"> • In their historical time frame group students will create a storyboard of their time frame. • The story sheet will provide clues for items they may want to look for during their scavenger hunt.
10		Group Discussion <ul style="list-style-type: none"> • Each group will read their story sheet and then share their stories. They will have to interact with the other groups to trade for the items they need to complete their storyboard. <ul style="list-style-type: none"> • Groups will break up and will find a student from a different group (a different color story) and exchange stories until each student has collected all five stories/colors.

15		Snack time!
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State Standards:

- There is interaction and interdependence between and among living and nonliving components of systems (Science 2.3, 4th grade).
- Organize a sequence of events to understand the concepts of chronology and cause and effect in the history of Colorado (Social Studies 1.1, 4th grade).
- The historical eras, individuals, groups, ideas, and themes in Colorado history and their relationships to key events in the United States (Social Studies 1.2, 4th grade).
- Connections within and across human and physical systems are developed (Social Studies 2.2, 4th grade).
- The origins, structure, and functions of the Colorado government (Social Studies 4.2, 4th grade).
- Earth and sun provide a diversity of renewable and nonrenewable resources (Science 3.1, 5th grade).
- Earth's surface changes constantly through a variety of process and forces (Science 3.2, 5th grade).
- Analyze historical sources from multiple points of view to develop an understanding of historical context (Social Studies 1.1, 5th grade).
- The historical eras, individuals, groups, ideas, and themes in North America from 1491 through the founding of the United States government (Social Studies 1.2, 5th grade).
- The foundations of citizenship in the United States (Social Studies 4.1, 5th grade).
- Changes in environmental conditions can affect the survival of individual organisms, populations and entire species (Science 2.1, 6th grade).
- Water on Earth is distributed and circulated through oceans, glaciers, rivers, ground water and the atmosphere (Science 3.2, 6th grade).
- Earth's natural resources provide the foundation for human society's physical needs. Many natural resources are nonrenewable on human timescales, while others can be renewed or recycled (Science 3.3, 6th grade).

Native Americans and the River (pre-1800s)

In the past, Native American tribes visited the Poudre River and its streams for over twelve thousand years. They would stay in one place only a short time before moving on.

Native Americans came to the river to **gather plants**, like willows, which they used for medicine. Many plants were also eaten. From the hills and mountains they would harvest trees to use for teepee poles.

They would **catch fish** to eat and to save for their travels or trade. Hunting bison or deer also provided food.

They also **drank water** from the river. To make sure the water was clean and safe they would dig a hole along the bank. The sand and gravel next to the river would clean the water for them as it filled.

The First Europeans: French Trappers (early to mid 1800s)

The first European people to come to the Poudre River were French fur trappers who came to the area to **hunt beaver**.

Beavers have very soft fur, which was used to make hats and coats. Beavers used to be common around the western U.S. In Colorado beavers mostly lived in the mountain streams. Beavers changed the way streams looked by **building dams** with trees from near the stream. Many animals used the beaver ponds as their homes.

The Poudre River was not the biggest trapping area in Colorado but was used by these explorers. The trappers would take the fur to trading centers to sell them. Many names that you might know are from these French trappers. The town of Laporte and the Cache la Poudre River are examples. **Trappers made the first maps** and pictures of the area.

Early Settlers (mid 1800s)

The first pioneers would look for Cottonwood trees, which only grow near water. The tall trees also gave pioneers shade and shelter. **The first people who settled in the area often built farms near the river or a stream.**

Farmers saw that many bison grazed on the prairie and decided that cows and sheep would be happy in the area. **Sheep and cattle** would walk around and eat grass and drink from the streams. Sometimes too many farm animals next to streams can kill plants next to the water.

Other people tried to build mines in the mountains to look for gold, silver, coal or other minerals. Not many of the mines were open for a long time.

These early farmers sometimes had floods that destroyed their homes. Larger floods even destroyed early towns. Floods can still happen today. Few people moved to the area until stagecoaches and railroads made travel easier.

Towns and Farms (early 1900s)

The first towns were built near the river so that people could get water easily. As more people moved to the towns and more farms were built it was harder for them to get water.

Some people moved to the area and came by stagecoach. The Poudre area was a stop as stagecoaches travelled across the country. After the stagecoach, railroads were built. To build the railroads, **trees from the mountains were cut to make railroad ties**. The logs were floated down the Poudre River. The railroad helped bring more people to towns and new farms.

Many large **irrigation ditches** were built to bring water from the river to the farms. Even some that brought extra water from western Colorado. But there was not enough water in the river for all of the farms. People began to fight over water. Eventually, the state government made laws about who could use the water. Many other states use these laws today.

Cities and Recreation (Modern Day)

As more people lived near the river, cities have tried to control the river so that floods do not cause too much damage. Sometimes they try to make the river straighter or move it away from buildings.

As the cities got larger more people took trips to the river or streams. Many people enjoy spending time at the river. People fish or **hike and spend time at the river**. People who lived in the towns and cities wanted to make sure that people could keep enjoying the river in the future.

In 1986, the national government made part of the river a Wild and Scenic river. This means that people will be able to visit and play at the river for a long time. It also means that the river is protected for plants and animals.

Exploring Your Data

The Exploring Your Data lesson was not implemented during the AquaBlitz pilot project due to time constraints. The rough outline below is intended as only a general outline and should be filled in to best suit your students age and learning needs. This lesson was envisioned to share and compare data between participating schools to gain understanding differences across the watershed. This would require a data management facilitator. However, during individual events sample data could supplement for lack of additional participants.



Title: Exploring Your Data		Time: 60 minutes
Facilitators:		Materials: <ul style="list-style-type: none"> Completed data sheets Sample data Google Forms version of data sheets
Purpose: The participants are expected to have a better understanding of the water quality data collected through data manipulation and graphing in order to contribute to the story map and compare data collected by all of the participating schools, as well as sample data and explore the differences in water chemistry between different elevations within the watershed.		
Learning Objectives: By the end of this session, participants will be able to: <ul style="list-style-type: none"> Demonstrate correct protocol for uploading data from field exercises. Demonstrate understanding of chemistry components through graphing and mapping exercises. 		
Prep Work		
<ul style="list-style-type: none"> If insufficient data coverage of the watershed is completed during the event, collect sample data from around the watershed to supplement data. Ideally from areas in both higher and lower elevations of the watershed. Data collected by the students should be reviewed and cleaned up by the facilitator as student data may vary widely and be incorrect. Pre-graph data to be aware of patterns and connections that can be explored with students. 		
Procedures		
Minutes	Lead Facilitator	Activities
10		Introduction <ul style="list-style-type: none"> What happens to data after it is collected? Why is it important to use data that is collected? What is the difference between collecting data once, or once every year, or month?
10		Upload Sample Datasets <ul style="list-style-type: none"> The class will have two sample datasets, one from high elevation and one from near the confluence.
10		Upload Student Datasets <ul style="list-style-type: none"> Students will put in their data from the AquaBlitz. The facilitator will then provide the total data
30		Comparing Data <ul style="list-style-type: none"> Students will graph several of the variables by elevation and discuss trends. Alternatively, the facilitator can implement the graphing and students can discuss. Alternate activity: Find long term data set from state samples or organization like RiverWatch. Good examples to graph would include dissolved oxygen and temperature over time. An inverse relationship usually exists. Inquiry/Assessment: What does our data tell us? Give some examples that might change our data results.

State Standards:

- There is interaction and interdependence between and among living and nonliving components of systems (Science 2.3, 4th grade).
- Connections within and across human and physical systems are developed (Social Studies 2.2, 4th grade).
- The decimal number system to the hundredths place describes place value patterns and relationships that are repeated in large and small numbers and forms the foundation for efficient algorithms (Math 1.1, 4th grade).
- Formulate, represent, and use algorithms to compute with flexibility, accuracy, and efficiency (Math 1.3, 4th grade).
- Number patterns and relationships can be represented by symbols (Math 2.1, 4th grade).
- Visual displays are used to represent data (Math 3.1, 4th grade).
- Appropriate measurement tools, units, and systems are used to measure different attributes of objects and time (Math 4.1, 4th grade).
- Earth and sun provide a diversity of renewable and nonrenewable resources (Science 3.1, 5th grade).
- Earth's surface changes constantly through a variety of process and forces (Science 3.2, 5th grade).
- Weather conditions change because of the uneven heating of Earth's surface by the Sun's energy. Weather changes are measured by differences in temperature, air pressure, wind and water in the atmosphere and type of precipitation (Science 3.3, 5th grade).
- The decimal number system describes place value patterns and relationships that are repeated in large and small numbers and forms the foundation for efficient algorithms (Math 1.1, 5th grade).
- Formulate, represent, and use algorithms with multi-digit whole numbers and decimals with flexibility, accuracy, and efficiency (Math 1.2, 5th grade).
- Number patterns are based on operations and relationships (Math 2.1, 5th grade).
- Visual displays are used to interpret data (Math 3.1, 5th grade).
- Changes in environmental conditions can affect the survival of individual organisms, populations and entire species (Science 2.1, 6th grade).
- Organisms interact with each other and their environment in various ways that create a flow of energy and cycling of matter in an ecosystem (Science 2.2, 6th grade).
- Complex interrelationships exist between Earth's structure and natural processes that over time are both constructive and destructive (Science 3.1, 6th grade).
- Water on Earth is distributed and circulated through oceans, glaciers, rivers, ground water and the atmosphere (Science 3.2, 6th grade).
- Earth's natural resources provide the foundation for human society's physical needs. Many natural resources are nonrenewable on human timescales, while others can be renewed or recycled (Science 3.3, 6th grade).
- Quantities can be expressed and compared using ratios and rates (Math 1.1, 6th grade).
- Formulate, represent, and use algorithms with positive rational numbers with flexibility, accuracy, and efficiency (Math 1.2, 6th grade).
- Visual displays and summary statistics of one-variable data condense the information in data sets into usable knowledge (Math 3.1, 6th grade).

Supplemental Material



Date and Time:

Site Name, Reach Number:

Recorder's Names:

Write your group members names.

Weather Observations:

Record any observations about the recent weather that may affect the stream assessment results.

Rate each of the following indicators from one to three. One is the lowest rating, which means that the stream is less healthy in that indicator. Three is the highest rating. The higher the total score, the healthier the stream is.

Habitat

Indicators	Scoring definition	Method	Score
Shade over channel	1. Stream has no shade 2. Some shade 3. Completely shaded	Look up and down stream, looking at three different points over the reach.	
Pools	1. No pools 2. Some pools and riffles 3. Many pools	Check along the entire reach. Steeper streams will have more pools.	
Particle size	1. Particles are in silt 2. A mixture of sizes (gravel and smaller, less than 2.5 inches) little to no silt 3. Gravel to cobble (2.5-10 inches), no silt	Look at three different locations to determine particle size.	
Large wood	1. No large wood in stream 2. Some large wood 3. Lots of large wood	Large wood is pieces larger than 6 inches in diameter and longer than 3 feet.	
Plant communities	1. No vegetation present 2. Vegetation not directly connected to stream 3. Vegetation connected to stream and can contribute organic material.	Look for plants that can contribute leaves or twigs (organic material) to stream.	

Habitat Observations:		Total Score:
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Hydrology

Indicators	Scoring definition	Method	Score
Floodplain connection	<ol style="list-style-type: none"> 1. No indication of active flooding 2. Some evidence of flooding 3. Clearly active 	Look up and down stream, looking at three different points over the reach, look for debris left by flooding.	
Stable banks	<ol style="list-style-type: none"> 1. Banks are eroding 2. Some evidence of unstable banks 3. Banks are not eroding 	Check along the entire reach, look for banks eroding into the floodplain.	
Disturbed soil	<ol style="list-style-type: none"> 1. Surface soil is disturbed (more than 25%) 2. Some disturbance (6-20%) 3. Very little disturbance (less than 1%) 	Check along entire reach, look for evidence of vehicle, foot or animal activity.	
Hydrologic diversity	<ol style="list-style-type: none"> 1. Little or no diversity 2. Some diversity 3. Lots of diversity 	Look for pools, riffles, large wood, boulders, side channels. Look also for sand bars, wet meadows or beaver ponds.	
Hydrology Observations:			Total Score:

Date and Time:

Site Name:

Recorder's Names:

Write your group members names.

Weather Observations: Record any observations about the recent weather that may affect the water quality results.

Test #1

Dissolved Oxygen

_____ ml of titration solution x 10 =

**ppm of
Dissolved
Oxygen**

Test #2

Temperature

Recorded in °F

°F

Test #3

pH

On the pH scale of 1-14

Test #4

Carbon Dioxide

_____ ml of titration solution x 100 =

**ppm of
Carbon
Dioxide**

Carbon Dioxide Test for results lower than 50 mg/L

_____ ml of titration solution x 50 =

**ppm of
Carbon
Dioxide**

Test #5

Nitrate

ppm

Test #6

Phosphate

ppm

Google Forms Instructions

1. Log into Gmail account. You must have a Gmail account to create a Google Forms document. Respondents do not need a Gmail account to fill out the form you create.
2. Navigate to Google Forms either through your email home page or by utilizing a search tool.
3. Select the Create New Form button in the lower right corner of the screen.
4. You may title your form and provide a description of the activity if you wish.
5. To create your question, simply type the question in the Question Title box. Additional space to provide instructions is located in the box directly below the question.
6. Select the response type. This will be what the respondent sees on screen when they are completing the form.
 - Text: short text response
 - Paragraph text: longer text response
 - Multiple choice: you create the possible responses
 - Check boxes: you create the possible responses, similar to Multiple choice
 - Choose from a list: same as Multiple choice and Check boxes
 - Scale: you will select the length of the scale (i.e. 1 to 5) and items on scale (i.e. 1 ppm to 5 ppm)
 - Grid: you will create a grid that will be filled out by the respondent (i.e. Column headings: session names, Row headings: usefulness of session from least useful to most useful)
 - Date: select options for filling in dates (i.e. when field data was collected)
 - Time: same as Date
7. Preview your form by selecting the View live form option at the top of the page.
8. When you are ready to share your form, select the Send form button in the top right corner. You can either send by entering email addresses of respondents or providing the Url. To make it easier for students, select the Short Url box.
9. Responses will automatically be sent to a new document, a Google sheet in your Google Drive, where you can review the responses.

[Edit this form](#)

Water Quality Data Sheet

The online form for water chemistry from the AquaBlitz. Copy the data from your group's field worksheet into the form below. Be sure that your data is correctly copied into the form.

Site Name

☐ Site Name☐ Site Name☐ Site Name☐ Other:

Date and Time

Date and time that the data was collected.

Month ▾	Day ▾	2015 ▾	31
---------	-------	--------	-----------

Hr ▾	:	Min ▾	AM ▾
------	---	-------	------

Data Collectors

Insert names

Weather Observations

Write your weather observations from the field form.

Dissolved Oxygen (mg/L)

Write answer in mg/L or parts per million (ppm), the number from the field data sheet.

Temperature (F)

Record the water temperature in Fahrenheit.

pH

Record the pH to two decimal points. (ex 0.00)

Carbon Dioxide (mg/L)

Write answer in mg/L or parts per million (ppm), the number from the field data sheet. If you completed the second test for results lower than 50 ppm, write that number.

Nitrate (mg/L)

Record results in mg/L or parts per million (ppm), from the field data sheet.

- ☐ less than 10 ppm
- ☐ 10 ppm
- ☐ 20 ppm
- ☐ 30 ppm
- ☐ 40 ppm
- ☐ greater than 50 ppm
- ☐ Other:

Phosphate (mg/L)

Record results in mg/L or parts per million (ppm), from the field data sheet.

- ☐ less than 1 ppm
- ☐ 1 ppm
- ☐ 2 ppm
- ☐ 3 ppm
- ☐ 4 ppm
- ☐ 5 ppm
- ☐ greater than 5 ppm
- ☐ Other:

Never submit passwords through Google Forms.

Native Americans and the River (pre 1800s)

In the past, Native American tribes visited the Poudre River and its streams for over twelve thousand years. They would stay in one place only a short time before moving on.

Native Americans came to the river to **gather plants**, like willows, which they used for medicine. Many plants were also eaten. From the hills and mountains they would harvest trees to use for teepee poles.

They would **catch fish** to eat and to save for their travels or trade. Hunting bison or deer also provided food.

They also **drank water** from the river. To make sure the water was clean and safe they would dig a hole along the bank. The sand and gravel next to the river would clean the water for them as it filled.

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Towns and Farms (late 1800s-1900s)	
Cities and Recreation (Modern Day)	

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The First Europeans: French Trappers (early to mid-1800s)

The first European people to come to the Poudre River were French fur trappers who came to the area to **hunt beaver**.

Beavers have very soft fur, which was used to make hats and coats. Beavers used to be common around the western U.S. In Colorado beavers mostly lived in the mountain streams. Beavers changed the way streams looked by **building dams** with trees from near the stream. Many animals used the beaver ponds as their homes.

The Poudre River was not the biggest trapping area in Colorado but was used by these explorers. The trappers would take the fur to trading centers to sell them. Many names that you might know are from these French trappers. The town of Laporte and the Cache la Poudre River are examples. **Trappers made the first maps** and pictures of the area.

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Early Settlers (mid 1800s)

The first pioneers would look for Cottonwood trees, which only grow near water. The tall trees also gave pioneers shade and shelter. **The first people who settled in the area often built farms near the river or a stream.**

Farmers saw that many bison grazed on the prairie and decided that cows and sheep would be happy in the area. Sheep and cattle would walk around and eat grass and drink from the streams. Sometimes too many farm animals next to streams can kill plants next to the water.

Other people tried to build mines in the mountains to look for gold, silver, coal or other minerals. Not many of the mines were open for a long time.

These early farmers sometimes had floods that destroyed their homes. Larger floods even destroyed early towns. Floods can still happen today. Few people moved to the area until stagecoaches and railroads made travel easier.

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Towns and Farms (late 1800s-early 1900s)

The first towns were built near the river so that people could get water easily. As more people moved to the towns and more farms were built it was harder for them to get water.

Some people moved to the area and came by stagecoach. The Poudre area was a stop as stagecoaches travelled across the country. After the stagecoach, railroads were built. To build the railroads, **trees from the mountains were cut to make railroad ties**. The logs were floated down the Poudre River. The railroad helped bring more people to towns and new farms.

Many large irrigation ditches were built to bring water from the river to the farms. Even some that brought extra water from western Colorado. But there was not enough water in the river for all of the farms. People began to fight over water. Eventually, the state government made laws about who could use the water. Many other states use these laws today.

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Cities and Recreation (Modern Day)

As more people lived near the river, cities have tried to control the river so that floods do not cause too much damage. Sometimes they try to make the river straighter or move it away from buildings.

As the cities got larger more people took trips to the river or streams. Many people enjoy spending time at the river. **People fish or hike and spend time at the river.** People who lived in the towns and cities wanted to make sure that people could keep enjoying the river in the future.

In 1986, the national government made part of the river a Wild and Scenic river. This means that people will be able to visit and play at the river for a long time. It also means that the river is protected for plants and animals.

Cites and Recreation (Modern Day)

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