

Field Study Day

Each chapter of *Conserving Missouri's Aquatic Ecosystems* prepares students for a hands-on activity to be performed on the field study day. The last activities in chapters 1–6 ask students to decide the best way to make and record their observations. They are then tasked with creating a data table or other recording system for use on the field study day. These data record pages then become part of their science journals. In chapters 7–9, students are prepared to sample invertebrates. A data record page for invertebrate sampling is provided as a copy page. Chapter 10 requires no new data record, but students may wish to modify or add to the data table they created in chapter 4. Depending on which chapters the class has completed, the equipment resources available, time constraints, number of adult assistants and other considerations, teachers will have many field day activity options from which to choose.

Field Study Activities Specified in *Conserving Missouri's Aquatic Ecosystems*

| <i>Conserving Missouri's Aquatic Ecosystems</i> Chapter | Field Study Activity |
|---|---|
| 1—Water Is Life | Water chemistry |
| 2—The Ultimate Recyclable | Weather conditions |
| 3—What's Your Watershed Address? | Land uses and site conditions |
| 4—Living In The Water 10—Fishing For Answers | Fish sampling (fishing) |
| 5—From Sun To Sunfish | Wildlife walk (direct observation and looking for sign) |
| 6—Missouri's Aquatic Ecosystems | Plant sampling |
| 7—Rivers And Streams 8—Lakes And Ponds 9—Swamps And Marshes | Invertebrate sampling |
| 9—Swamps And Marshes | Soil testing (wetland sites only) |

Possible combinations:

Water chemistry + Weather conditions

Land uses and site conditions + Wildlife walk

Plant sampling + Soil testing

Keep group sizes down for easier management. Have at least one adult at each station, or per every 10 students. One adult for every 5–10 students is ideal. If you have a large number of students, break each station into sub-stations and rotate or conduct simultaneous subgroups. For example, Water chemistry + Weather conditions could consist of the following five substations:

- weather and temperature
- pH and conductivity
- turbidity, color and odor
- dissolved oxygen
- nitrates

Allow at least 30 minutes per station with time for rotation. Three stations in the morning and three after lunch works well. Most students are used to having 30 minutes or less for lunch. A lunch break of no more than 45 minutes will keep the program moving and keep students focused. Make an activity rotation schedule and have enough copies for all adult volunteers.

Sample Rotation Schedule

| Station | Field Study Activity | Time slot | | | | | | |
|---------|-------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | | 8:30–9:15 | 9:20–10:05 | 10:10–10:55 | 11:00–11:45 | 11:50–12:35 | 12:40–1:25 | 1:30–2:15 |
| 1 | Water chemistry + Weather | Red team | Orange team | Yellow team | Green team | Lunch | Blue team | Purple team |
| 2 | Land uses and site conditions | Orange team | Yellow team | Green team | Blue team | Lunch | Purple team | Red team |
| 3 | Wildlife walk | Yellow team | Green team | Blue team | Purple team | Lunch | Red team | Orange team |
| 4 | Plant sampling + Soil testing | Green team | Blue team | Purple team | Red team | Lunch | Orange team | Yellow team |
| 5 | Fish sampling | Blue team | Purple team | Red team | Orange team | Lunch | Yellow team | Green team |
| 6 | Invertebrate sampling | Purple team | Red team | Orange team | Yellow team | Lunch | Green team | Blue team |

Review sections on Planning a Successful Field Trip and Safety Precautions and Concerns.

The morning of the field trip or one day prior, check the field site. If you are having the students bring their lunch, have the school cafeteria make up some sack lunches for those that forget. Remember that all food, drink and sanitation items are pack in/pack out unless other arrangements are made.

If you have not already done so, compile a list of all students participating in the trip and provide a copy to the school office. Post on the classroom door or other conspicuous location a sign indicating the destination of the class trip and departure and return times. Have a way (cell phone, two-way radio, etc.) to contact the school should an emergency arise.

In case of sudden changes in weather, such as rainstorms, do not seek shelter around water or under trees in lightening storms. In violent weather, the bus may be a vital refuge. Insist that the bus and driver remain in the immediate vicinity during the entire event. Should an emergency arise, finding the driver and waiting for him or her to return to the area could result in an unacceptable delay. Of course, a first-aid kit and life preserver or reach pole are musts for field trips around water.

Checklist for teachers—day of event

- Cell phone
- First-aid kit
- Life preserver or reach pole
- Fishing tackle
- Aquatic studies equipment
- Copies of instructions for each activity for each station, group or student
- Copies of activity rotation schedule for all adult volunteers
- Cooler with water and ice
- Paper cups (no styrofoam!)
- Trash bags
- Hand sanitizer
- Toilet paper
- Soap and water
- Paper towels
- Blankets, towels, or tarps for students to sit on at lunch
- Class trip participants, departure and return times left at classroom and school office
- Remind students to bring their journals and pens or pencils!

Field Study Procedure

1. Load students. As students walk on the bus, take a head count. Have adult volunteers ride on the buses or in separate vehicles, whichever way your school requires or allows. Pass out name tags.
2. Upon arrival at the site, unload buses. Have adult volunteers get their groups of students together.
3. Review the fishing rules for the site and field trip manners. Remind students of safety precautions:
 - Stay on the path or in the designated area for each activity.
 - Stay out of the water except as instructed.
 - Never wade into water deeper than your knees.
 - No pushing or shoving.
 - No running or “horseplay” with equipment or around water.
 - Never stand behind any student while fishing.
 - Bring litter back to the classroom or place in appropriate receptacles.
4. Have each group of students help with equipment and supplies for activities.
5. Have each adult volunteer lead their group to their designated activity area.
6. Conduct the activities and rotate students as scheduled.
7. When preparing to leave, have adult volunteers collect equipment from their students.
8. Before leaving the site, have students pick up their trash.
9. When boarding the bus, take a roll call to make sure all students are on board.
10. Congratulate students on a successful field study day and recognize your assistants!

Managing Student Behavior While Learning Outdoors

Students are accustomed to learning in an indoor environment. They know the rules and expectations, have established routines for focusing attention and are bounded by the limited space available. Outdoors, these well established rules, routines and expectations are quickly “forgotten.” Additionally, outside there are more distractions and the fresh air increases energy levels. Your task when teaching outdoors is to work with students’ increased enthusiasm and energy while maintaining focus so that learning occurs and student safety is maintained. Here are some ways to maximize control in the outdoor environment.

Set ground rules about outdoor behavior before leaving the classroom. Make a list of the behaviors which you believe to be essential such as staying on the path, bringing litter back to the classroom, not pushing or shoving, etc. Reinforce this behavior when students are gathered outside, before beginning any activities. Preplan ways to handle disruptive behavior such as having students sit out from an activity or otherwise restricting their freedom.

Set physical boundaries beyond which students cannot wander. Use clear landmarks such as a specific patch of trees or a path as your boundary markers. Don’t partner up students who wind each other up. Designate a “home base”—usually your debriefing area. If students are scattering to do an activity, set a clear signal which indicates that the activity is over and students should return to home base.

Gather students in a circle, preferably seated, when debriefing an activity, so that you have everybody’s attention and everyone can participate. Be aware of the volume of your voice when you are talking outside. Debrief away from competing noises. Ask for eye contact. Avoid speaking to a group with your back to the sun or an interesting distraction. Set the tone for the type of learning which you want to happen by speaking softly if you want to focus attention or being energetic if the work to be done is active.

Be aware of weather conditions and physical fitness levels of students. Many students will whine about being cold, hot or about the long distance that they have to walk. You need to read when these complaints are serious and need to be heeded or when the student just requires some positive but firm encouragement. If you are walking for a distance, make sure that one adult leads the group and one adult brings up the rear, encouraging the slower walkers and making sure that no stragglers get left behind. Be vigilant. Be aware of students’ whereabouts and watch for behavior that may be disruptive or destructive to the host site or natural environment.

Use the buddy system. Students should be paired with a buddy in their group all day. Students should notify their teacher or other adult when they are going to the restroom, and they should take their buddy with them. Have all students, parents and teachers wear nametags with group number, or class and grade on the nametags. Color-coding each group’s tag may be helpful.

Adapted from ecomentors.ca

ROCKY BOTTOM INVERTEBRATE SAMPLING

Required materials:

(One set for each group of students to be working simultaneously)

- Kick seine (a fine 3 × 3 foot net with 1/16 inch mesh and supporting poles on each side)
- Small hand rake
- Invertebrate Identification Card
- Invertebrate Sampling—Water Quality Investigation Data Sheet
- Small magnifier boxes/magnifying glasses
- Tweezers or forceps
- White ice cube trays for sorting organisms
- Squirt or spray bottle or watering can
- Clipboards
- Pens or pencils

Procedure

1. Select a riffle typical of the stream, that is, a shallow fast-moving area with a depth of 3–12 inches and cobble-sized stones (2–10 inches) or larger.
2. Place the kick seine or screen at the downstream edge of the riffle. Be sure that the bottom of the seine or screen fits tightly against the stream bed so that no insects escape under the net. You may want to use rocks to secure the net against the stream bottom. Also, don't allow any water to flow over the top of the net.
3. Sample the stream bed for a distance of 3 feet upstream of the kick seine. Firmly and thoroughly rub your hands over all rock surfaces (top, sides and bottom) to dislodge any attached insects. Carefully place any large rocks outside of your 3 foot sampling area after you have rubbed off any invertebrates. Stir up the bed with hand rake until the entire 3 foot square area has been worked over. All detached insects will be carried into the net. Then for at least 60 seconds, kick the stream bed with a sideways shuffling motion towards the net. Disturb the first few inches of sediment to dislodge burrowing organisms.
4. Remove the seine with a forward-scooping motion. Firmly grab the bottom of the net so that your sample does not spill out of the net. The idea is to remove the net without allowing any insects to be washed under, washed from the net surface or fall off the net.
5. Place the net on a flat, well-lit area. Using tweezers or fingers, pick all the insects from the net and place them in your ice cube trays (half full of water). Any creature that moves, even if it looks like a worm, is part of the sample. Look closely, since most insects are only a fraction of an inch long.
6. Critters will stop moving as the net dries. Occasionally wetting the net using the squirt or spray bottle or watering can will cause the insects to move, making them easier to spot. Watering the net is especially important on hot, dry days.
7. You may also want to sort your insects into look-a-like groups as you pick them. This will make your identification quicker when you are ready to record results on your survey form. For example, put all organisms with legs in one ice cube tray section and all organisms with no legs in another section, etc.

MUDDY BOTTOM INVERTEBRATE SAMPLING

Required materials: *(One set for each group of students to be working simultaneously)*

- D-Frame aquatic dip net with mesh of $\frac{1}{32}$ inch and a 4-foot pole
- Clean/new toilet brush
- Plastic shallow white pan
- Small magnifier boxes/magnifying glasses
- Tweezers or forceps
- White ice cube trays for sorting organisms
- Invertebrate Identification Card
- Invertebrate Sampling—Water Quality Investigation Data Sheet
- Clipboards
- Pens or pencils

Procedure

1. The four main habitats of muddy bottom water bodies are: steep banks, vegetated margins, silty bottom with organic matter, woody debris with organic matter and sand/rock/gravel. Look for these habitats.

Steep banks/vegetated margins

This habitat is the area along the bank and the edge of the water body consisting of overhanging bank vegetation, plants living along the shoreline, and submerged root mats. Vegetated margins may be home to a diverse assemblage of dragonflies, damselflies and other organisms. Move the dipnet in a bottom-to-surface motion, jabbing at the bank to loosen organisms.

Silty bottom with organic matter

Silty substrates with organic matter can be found where the water is slow moving and where there is overhanging vegetation or other sources of organic matter. These silty substrates harbor burrowing organisms such as dragonflies or burrowing mayflies. Samples are collected by moving the net forward with a jabbing motion to dislodge the first few inches of organic layer.

Woody debris with organic matter

Woody debris consists of dead or living trees, roots, limbs, sticks, cypress knees and other submerged organic matter. It is a very important habitat. The wood helps trap organic particles that serve as a food source for the organisms and provides shelter from predators, such as fish. To collect woody debris, hold the net under the section of wood you wish to sample, such as a submerged log. Use the toilet brush to scrub the surface of the log. It also is good to dislodge some of the bark as organisms may be hiding underneath. You also can collect sticks, leaf litter, and rub roots attached to submerged logs. Be sure to thoroughly examine any small sticks you collect with your net before discarding them. There may be caddisflies, stoneflies, riffle beetles, and midges attached to the bark.

Sand/rock/gravel

Large rocks provide the most productive habitat. The bottom can be sampled by moving the net forward with a jabbing motion to dislodge the first few inches of gravel, sand or rocks. You may want to gently wash the gravel in your screen bottom bucket and then discard the gravel. If you have large rocks (greater than two inches diameter) you should also kick the bottom to dislodge any burrowing organisms.

2. Each time you sample you should sweep the mesh bottom of the D-Frame net back and forth through the water (not allowing water to run over the top of the net) to rinse fine silt from the net. This will avoid a large amount of sediment and silt from collecting in the pan and clouding your sample.
3. After collecting your samples, dump the net into a shallow white pan filled with a few inches of water. You should dump your debris into your pan of water after every three scoops to avoid clogging the net. Dumping your net periodically also will prevent you from having to sort a great deal of debris all at once. Collect organisms from your pan and place like organisms in ice cube trays for identification.
4. You also may want to sort your insects into look-a-like groups as you pick them. This will make your identification quicker when you are ready to record results on your survey form. You can use plastic ice cube trays to do this. For example, put all organisms with legs in one section and all organisms with no legs in another section, etc.

IDENTIFYING INVERTEBRATES

Once you have collected the organisms, sort and identify them using the Invertebrate Identification Card. Not all organisms you may find are listed on the card. For instance, invertebrates such as whirligig beetles, water striders, and predaceous diving beetles are not included on the survey sheet. They are surface breathers and do not provide any indication of water quality.

Specimens can be put into magnifier boxes to ease identification. Use characteristics such as body shape, number of legs, tails and antennae, size, color, swimming movement and gill locations to identify organisms. When using the Invertebrate Identification Card, remember to read the descriptions for each organism. Also remember that the lines on the card indicate the sizes of the organisms. However, if you catch a young invertebrate that has just hatched and has not yet reached full size, it may be smaller than indicated on the card.

To identify the organisms, use body shape, size and other characteristics (number of legs and tails), because the same family can vary in size and color. **Ask yourself the following questions to identify an organism:**

- How large is the organism?
- Is the body long and slender, round, or curved?
- Does the organism have any tails? How many?
- Does the organism have any antennae?
- Does the organism have legs? How many? Where?
- Is the body smooth and all one section or is it segmented (two or more distinct sections)?
- Does the organism have any gills (fluffy or plate-like appendages)?
- Where are the gills located? Sides, back, underside, under its legs?
- Does it have pinching jaws like a beetle larvae?
- Are any legs or antennae missing because they were broken off in the net?
- What color is the organism?
- Does the organism swim underwater or remain on the surface?

After identifying your organisms, record your results on the Invertebrate Sampling—Water Quality Investigation data sheet. Return specimens to the water after you have finished. Tabulate your results to determine the water quality using the instructions on the survey sheet. Count the number of types of invertebrates (not the number of individuals) in each column and multiply by the index value at the bottom of the column. The rating is based on the diversity and sensitivity of the organisms, not the number of individual organisms found. Add the subtotal for each column to arrive at your final water quality rating.

INVERTEBRATE SAMPLING— WATER QUALITY INVESTIGATION

Group: _____ (names)

Date: _____

Location: _____

Invertebrate Occurrence

| Sensitive | Somewhat Sensitive | Tolerant |
|--|---|---|
| ___ caddisfly larvae ___ hellgrammite ___ mayfly nymphs ___ gilled snails (right) ___ riffle beetle adult ___ stonefly nymphs ___ water penny larvae | ___ beetle larvae ___ clams/mussels ___ crane fly larvae ___ crayfish ___ damselfly nymphs ___ dragonfly nymphs ___ scuds ___ sowbugs ___ fishfly larvae ___ alderfly larvae ___ watersnipe fly | ___ aquatic worms ___ blackfly larvae ___ leeches ___ midge larvae ___ pouch snails (left) ___ other snails (flat) |
| Count the number of types (not number of individuals) ___ × 3 = ___ index value | Count the number of types (not number of individuals) ___ × 2 = ___ index value | Count the number of types (not number of individuals) ___ × 1 = ___ index value |
| Now add together the three index values from each column for your total index value. Total index value = ___ | | |

Compare this total index value to the following ranges of numbers to determine the water quality of your stream. Good water quality is indicated by a variety of different kinds of organisms and the sensitivity of the organisms, not the number of individual organisms found.

Water Quality Rating

_____ Excellent (>22) _____ Good (17–22) _____ Fair (11–16) _____ Poor (<11)

Unit Summation

The structured inquiry of the field study activities guides students to formulate testable questions and to select appropriate investigative methods in order to obtain evidence relevant to those questions. Students develop an understanding of ecological concepts by direct contact with and observation of the natural world. And they understand the processes by which scientists form and evaluate hypotheses about the natural world by doing those things themselves. In the unit summation, students analyze their data, draw conclusions and propose their own solutions to environmental problems.

Instructors will have to decide for themselves on a class-by-class basis how much and what kind of direction students need in analyzing their data. With one exception—invertebrate sampling—no method for data analysis or interpretation is provided in the unit. To the greatest extent possible, challenge students to decide for themselves what reasonable conclusions they can draw from their observations.

Guide students back to the initial question: Is it safe to swim in/drink from/eat fish from their particular body of water? Use the Field Study Report copy page that follows and the Writing Scoring Guide from Chapter 4, or create your own instructions.

Science relies upon communication of results and justification of explanations. To complete the unit, consider using a jigsaw or carousel procedure for having the class report their findings, conclusions and solutions. That is, task each working group with reporting on a different part of the field study, and assemble a whole-class proposal to conserve the aquatic ecosystem they studied. Don't miss the opportunity to challenge students to create a personal action plan to implement their solutions!

Objective

Report, analyze and draw conclusions from observations and data collected in the field study of an aquatic ecosystem.

Directions

Work with your partners to write a report on your field study of an aquatic ecosystem. Each person should write and turn in his or her own work. Use the following format:

1. In the first paragraph, briefly summarize what you did on your field study day to help you understand your aquatic ecosystem. End the paragraph by stating, in your own words, what you wanted to discover about your aquatic ecosystem.
2. In your second paragraph, briefly summarize the observations you made and the data you obtained. Refer to your data tables, notebook entries and other records.
3. Third, state what reasonable conclusions you can draw from your observations. What more do you need to know about the aquatic ecosystem you studied and how could you obtain that information?
4. In the fourth paragraph, self-evaluate your data gathering and recording techniques. Were there observations that you didn't know how to record or information you were unable to capture? Were there instances in which you expected to find data but did not? Did you need to reorganize your data after you had collected it? What would you do differently "next time"? What would you keep the same? Can you identify potential sources of error? How might an error in your data affect your conclusions?
5. Begin the next paragraph by restating as a question what you wanted to discover about your aquatic ecosystem. Then answer the question and justify your answer with your own data (refer to paragraphs 2 and 3).
6. Finally, propose solutions to any environmental problems you found or which your aquatic ecosystem might face. What could you personally do to help conserve the aquatic ecosystem you studied?

Enrichments

Using Missouri Department of Conservation Resources

Your Missouri Department of Conservation education consultant or outdoor skills specialist can assist you in arranging field trips, guest speakers and demonstrations. They also have enrichment resources you may borrow, including materials and prepared activities. To find the contacts in your area, check the directory included with this publication, call 573/751-4115, visit our website at mdc.mo.gov/teacher/contacts/ or write to Outreach and Education Field Unit Chief, Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65102-0180.

Classroom Visits and Demonstrations

Conservation education consultants or outdoor skills specialists may be able to arrange for guest speakers to provide demonstrations. Class visitors may include naturalists, fisheries biologists, conservation agents, Master Naturalists or Stream Team Volunteers. Demand for these educational services is very high—please allow a minimum of six weeks prior to the date you would like the program.

Discovery Trunks

Check with your conservation education consultant or outdoor skills specialist about other materials that may be available in your area. These materials may include Discovery Trunks filled with activities and reference materials about Missouri plant and animal life and other manipulatives you may borrow and use in the classroom.

Enviroscape Demonstrations

The Enviroscape is a three-dimensional model of a watershed that demonstrates how stream health and water quality are the products of land use practices within a watershed. One may be available for loan, or a class visit may be arranged. Some regions also have groundwater models. Ask your conservation education consultant or outdoor skills specialist about what is available in your area.

Stream Trailer Demonstrations

The Stream Trailer is a large model of a flowing stream mounted on a trailer. The model consists of a metal box filled with a plastic material that simulates sediment. A battery-powered pump circulates water through it to portray a range of fluvial processes, including erosion and sedimentation. The model is very effective in demonstrating complex concepts and illustrating conservation techniques that can stabilize and restore streams. This self-contained unit is well-suited for outdoor presentations but can be brought indoors in larger spaces such as gymnasiums.

Educator Workshops

If you have a strong professional interest in conservation or want to enrich your teaching, consider signing up for a Missouri Department of Conservation educator workshop. Many workshops are provided in cooperation with colleges or universities throughout the state and offer undergraduate or graduate credit hours. Workshops that are not for credit are free or require a small registration fee.

Check mdc.mo.gov/teacher/workshops/ for dates, locations and contact information to register. Workshops and events listed on this site are updated periodically, so check back to see what new ones have been added. The Missouri Department of Conservation also offers many public events, programs and workshops that are great educational opportunities for teachers and students. If you don't find a workshop that fits your needs, contact your conservation education consultant and outdoor skills specialist to find out what they may be able to provide.

Enrichments from Project WET, Project WILD Aquatic and the *Stream Team Middle School Activity Guide*

| <i>Conserving Missouri's Aquatic Ecosystems Chapter</i> | Project WILD Aquatic Activities | Project WET Activities | <i>Stream Team Middle School Activity Guide Activities</i> |
|---|--|---|---|
| 1—Water Is Life | <ul style="list-style-type: none"> • How Wet Is Our Planet? • Something's Fishy Here! • What's in the Water? | <ul style="list-style-type: none"> • Adventures in Density • Choices and Preferences, Water Index • Common Water • Drop in the Bucket • Every Drop Counts • H2Olympics • Hangin' Together • Is There Water on Zork? • Water Meter • What's the Solution? | <ul style="list-style-type: none"> • Governor's Solution • Points of View |
| 2—The Ultimate Recyclable | <ul style="list-style-type: none"> • Alice in Waterland • Water Wings • What's in the Air? • Where Does Water Run? | <ul style="list-style-type: none"> • Dust Bowls and Failed Levees • Get the Ground Water Picture • Incredible Journey • Piece It Together • Poetic Precipitation • Poisoned Pump • Sparkling Water • Thirsty Plants • Water Models • Wet Vacation • Where Are the Frogs? | <ul style="list-style-type: none"> • Catch that Rainfall! |
| 3—What's Your Watershed Address? | <ul style="list-style-type: none"> • Watershed • Where Does Water Run? | <ul style="list-style-type: none"> • Branching Out! • Just Passing Through • Rainy-Day Hike • Sum of the Parts | <ul style="list-style-type: none"> • Land Use and Watershed Pollution • Missouri River Basins and Watersheds • Riparian Corridor—What Is It? |
| 4—Living In The Water | <ul style="list-style-type: none"> • Fashion a Fish • Fishy Who's Who | <ul style="list-style-type: none"> • Water Address | |
| 5—From Sun To Sunfish | <ul style="list-style-type: none"> • Aquatic Times • Designing a Habitat • Migration Headache | <ul style="list-style-type: none"> • Water Address | <ul style="list-style-type: none"> • Aquatic Stream Habitats • Stream Substrate Habitat |
| 6—Missouri's Aquatic Ecosystems | <ul style="list-style-type: none"> • Aquatic Roots • Edge of Home • Watered-Down History | | |

| <i>Conserving Missouri's Aquatic Ecosystems Chapter</i> | Project WILD Aquatic Activities | Project WET Activities | <i>Stream Team Middle School Activity Guide Activities</i> |
|--|---|---|--|
| 7—Rivers and Streams | <ul style="list-style-type: none"> • Blue Ribbon Niche • Riparian Retreat • To Dam or Not to Dam • Water Canaries | <ul style="list-style-type: none"> • After Math • Macroinvertebrate Mayhem | <ul style="list-style-type: none"> • Aquatic Stream Habitats • Captured Critters • Floodplain Functions • Inventory/Field Study • Riparian Corridor—What Is It? • Short Float • Stream Discharge • Stream Substrate Habitat • Water, Sediment, Energy, and Vegetation |
| 8—Lakes and Ponds | <ul style="list-style-type: none"> • Glass Menagerie • Micro Odyssey • Pond Succession | <ul style="list-style-type: none"> • Macroinvertebrate Mayhem | |
| 9—Swamps and Marshes | <ul style="list-style-type: none"> • Dragonfly Pond • Wetland Metaphors | <ul style="list-style-type: none"> • Capture, Store, Release • Life in the Fast Lane • Macroinvertebrate Mayhem • Wetland Soils in Living Color | <ul style="list-style-type: none"> • Wetland Madness • Wetland Migration |
| 10—Fishing For Answers | <ul style="list-style-type: none"> • Living Research: Aquatic • Heroes and Heroines • Net Gain, Net Activity | | <ul style="list-style-type: none"> • Governor's Solution • Personal Commitment to Stewardship • Points of View • Sensory Development • Voices From the Wilderness |

Service Learning with Missouri Stream Teams

Forming a school Stream Team is a great way to teach students about stream ecology. The Stream Team program provides an opportunity for all interests to get involved in river conservation. The program is sponsored by the Missouri Department of Conservation, the Missouri Department of Natural Resources and the Conservation Federation of Missouri. These three groups provide different strengths, resources and areas of expertise to volunteers. Stream Team membership is free to any interested citizen, family or organization. With 3,000 teams on board, an estimated 60,000 members are working to improve our streams. Missouri leads the nation in volunteer stream organizations. The Stream Team program encourages members to speak on behalf of Missouri's stream resources.

Stream Team projects are chosen according to each team's interests and local needs. Teams may adopt any stream or river of their choice, but adoption is not mandatory. From the largest rivers in the state to the smallest backyard tributaries, groups have adopted nearly 15,000 miles of flowing water. Stream Team coordinators can also help set up partnerships with other teams in your area. Stream Teams began monitoring the water quality of adopted streams in 1993. The Stream Team Volunteer Water Quality Monitoring program provides training, equipment and information to better understand our stream systems and the problems and opportunities they face. Stream Team can help you plan hands-on service learning projects such as litter control, streambank stabilization, streamside tree planting, water quality monitoring, and storm drain stenciling or match you with an agency or organization with an ongoing project. The Stream Team Academy offers continuing education on natural resources. Workshops have been held on understanding streams, fish identification, crayfish, herpetology, mussels, hellbenders, tree planting and groundwater.

If you'd like to start a Stream Team or get involved in similar efforts in your area, contact a Stream Team coordinator at 800/781-1989 or go to mostreamteam.org. The *Stream Team Middle School Activity Guide* by Mark Van Patten is available at mostreamteam.org.

Project WET & Project WILD Aquatic

Project WILD Aquatic (Wildlife In Learning Design) and Project WET (Water Education for Teachers) are two of the most widely used conservation and environmental education programs among educators of students in grades K–12. Project WILD Aquatic emphasizes aquatic wildlife and aquatic ecosystems. Project WET promotes awareness, appreciation, knowledge and stewardship of water resources. The activities found in Project WILD Aquatic and Project WET stimulate students' critical and creative thinking, develop students' ability to make informed decisions on environmental issues, and instill in students the commitment to take responsible action on behalf of the environment. The instructional materials are designed to support state and national academic standards appropriate for grades K–12. The activities can easily be adapted to meet the learning requirements for academic disciplines ranging from science and environmental education to social studies, math and language arts. Educators may choose one or more project activities with which to teach a concept or skill. The activities may be integrated into existing courses of study, or an entire set of activities may serve effectively as the basis for a specific course. Each activity contains all the information needed to conduct that activity including objectives, method, background information, a list of materials needed, procedures, evaluation suggestions, recommended grade levels, subject areas, duration, group size, setting and key terms. A glossary is provided, as well as a cross-reference by topics and skills.

Project WET and Project WILD Aquatic Training

To obtain these instructional materials, educators participate in a professional development workshop that is fun-filled and interactive, providing hands-on experiences in conducting activities and integrating them into the class curriculum. In Missouri, Project WILD is sponsored by the Missouri Department of Conservation and Project WET is sponsored by the Missouri Department of Natural Resources. Both agencies coordinate and conduct training. For additional information about the Projects to obtain training, contact your Missouri Department of Conservation education consultant or visit the links listed below:

- mdc.mo.gov
- dnr.mo.gov
- projectwild.org
- projectwet.org

Reference Materials for Teacher Background

The Missouri Department of Conservation publishes a number of free instructional resources for educators. These items include posters, activity books and much more. Most of the recommended reference materials are available free of charge from the Missouri Department of Conservation. Many publications are also available online. To get a copy of our Materials Request Form or specific publications, call your Conservation education consultant or outdoor skills specialist, visit our website at mdc.mo.gov/teacher/materials, e-mail your request to pubstaff@mdc.mo.gov or write to Publications, Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65102-0180.

Publications available free of charge from the Missouri Department of Conservation

| Publication Title | Inventory Number | Web Address |
|---|------------------|--|
| African Clawed Frogs | SCI013 | Not on the Web |
| DVD Compilation for <i>Conserving Missouri's Aquatic Ecosystems</i> | | Some videos are available on the Web. See pages 282 and 283. |
| Fishing Regulations Summary | E00606 | mdc.mo.gov/2115 |
| Start a Missouri Stream Team | FIS182 | mdc.mo.gov/58 |
| Help Stop Aquatic Hitch Hikers | FIS002 | Not on the Web |
| Introduction to Crayfish | FIS011 | mdc.mo.gov/7913 |
| Introduction to Fishing | FIS152 | mdc.mo.gov/3267 |
| Introduction to Missouri Fishes | FIS020 | mdc.mo.gov/fish/fishid/ |
| Kids Fishing Book | E00092 | Not on the Web |
| Know Missouri's Catfish | FIS003 | mdc.mo.gov/15569 |
| Life Within the Water | FIS034 | Not on the Web |
| Map: Smallmouth Bass | FIS019 | Not on the Web |
| Map: Trout Fishing In Missouri | FIS210 | mdc.mo.gov/13260 |
| Missouri Marsh Birds | E00042 | mdc.mo.gov/node/9017 |
| Missouri Toads and Frogs | E00430 | mdc.mo.gov/8262 |
| Missouri Turtles | E00468 | mdc.mo.gov/8273 |
| Missouri Wetlands & Their Management | SCI150 | mdc.mo.gov/7797 |
| Now That I'm a Stream Team... | FIS188 | mdc.mo.gov/57 |
| Nuisance Aquatic Plants in Missouri Ponds and Lakes | FIS110 | mdc.mo.gov/8418 |

| Publication Title | Inventory Number | Web Address |
|---|-------------------------|--|
| Poster: Exploring Missouri Wetlands | E00003 | Not on the Web |
| Poster: Missouri Fishes | E00013 | Not on the Web |
| Poster: Missouri Pond Life | E00002 | Not on the Web |
| Poster: Missouri Stream Life | E00016 | Not on the Web |
| Poster: Rivers and Streams: Missouri Currents | E00509 | Not on the Web |
| Poster: Salamander | E00089 | Not on the Web |
| Poster: Toads & Frogs | E00012 | Not on the Web |
| Poster: Wetlands & Waterfowl | E00115 | Not on the Web |
| Stream Insects/Crustaceans ID | STR250 | Not on the Web |
| Stream Team Inventory Guide | FIS193 | Not on the Web |
| <i>Stream Team Middle School Activity Guide</i> | | mdc.mo.gov/15571 |
| Streets to Streams Guide | E00428 | Not on the Web |
| Streets to Streams Video | E00447 | Not on the Web |
| Understanding Streams | FIS192 | mdc.mo.gov/7262 |
| Volunteer Water Quality Monitoring | FIS049 | Not on the Web |
| Watershed Management Placemat | FIS273 | Not on the Web |
| Watershed Protection Practices | F00050 | mdc.mo.gov/441 |
| What Happened to the Stream in My Backyard? | STR238 | mdc.mo.gov/8969 |
| Zebra Mussels: Missouri's Most Unwanted | FIS013 | mdc.mo.gov/8260 |

Publications for sale by the Missouri Department of Conservation

For-sale publications are available at Missouri Department of Conservation's nature centers or at **mdcnatureshop.com**. Schools and teachers may be eligible for a 30 percent education discount on Missouri Department of Conservation products. For more information, call toll-free (877) 521-8632.

Pond Life: Revised and Updated (A Golden Guide from St. Martin's Press) by George K. Reid is widely available (ISBN-10: 0307240177, ISBN-13: 978-0307240170) from book retailers.

WOW! The Wonders of Wetlands (Environmental Concern Inc. and The Watercourse, 2003) can be ordered from Project WET at store.projectwet.org/.

DVD Compilation for *Conserving Missouri's Aquatic Ecosystems*

Video Package/Menu

| Chapter | Activity | Title | Time |
|---------|------------|---|-------|
| 1 | 1.8 | Storm Drain Stenciling | 6:11 |
| 4 | 4.2 | Missouri Hatcheries | 3:30 |
| 4 | 4.4 option | Big Bluegill | 5:39 |
| 4 | 4.4 option | Paddlefish | |
| 4 | 4.4 option | Lake Sturgeon | |
| 4 | 4.4 option | Just Below The Surface (Grotto Sculpin) | 9:37 |
| 4 | 4.5 | Missouri Mussels | 6:58 |
| 4 | 4.5 option | Alligator Snapper Trapper | 4:38 |
| 4 | 4.5 option | Cottonmouth! | 6:47 |
| 4 | 4.5 option | So Close To Home (St. Louis Eagle Days) | 5:58 |
| 4 | 4.5 option | Hellbender Mystery | 6:54 |
| 4 | 4.5 option | The Trouble with Success (Otter Management) | 5:02 |
| 4 | 4.5 option | Secretive Salamanders | 4:20 |
| 4 | 4.5 option | Taneycomo Turtles | 5:05 |
| 5 | 5.4 | Trout Eggs | |
| 5 | 5.4 | Ozark Rainbows | |
| 5 | 5.6 | Leaping Exotics (Carp) | 6:04 |
| 5 | 5.8 | St. Francis Crayfish | 5:00 |
| 6 | 6.2 | Zebra Mussel | 5:36 |
| 6 | 6.2 | Purple Loosestrife | 5:02 |
| 6 | 6.3 | Topeka Shiner | 5:12 |
| 6 | 6.3 | Niangua Darter | 4:45 |
| 6 | 6.5 | Stream Teams | 6:44 |
| 6 | 6.6 | Wranglers of the Deep | 5:07 |
| 6 | 6.6 | Crustacean Calculation | 4:30 |
| 7 | 7.2 | Streams: The Force of Life | 19:00 |
| 7 | 7.2 option | River of Many Uses (Missouri River Flow Animation) | 7:51 |
| 7 | 7.2 option | Mississippi River Monitoring | 7:29 |

| Chapter | Activity | Title | Time |
|---------|-------------|--|------|
| 7 | 7.5 | Stream Invertebrate Sampling | |
| 8 | 8.2 | CAP Lakes | 3:40 |
| 8 | 8.2 | Farm Pond Stocking | 4:06 |
| 8 | 8.5 | Pond Invertebrate Sampling | |
| 9 | 9.2 | A Southeast Story | 8:08 |
| 9 | 9.2 option | A Winter Walk (Dresser Island Wetland) | 6:14 |
| 9 | 9.2 option | A Day on a Marsh | |
| 9 | 9.2 option | Grand Pass Conservation Area | |
| 9 | 9.5 | Wetland Invertebrate Sampling | |
| 10 | 10.3 | Bass Catch & Release | 4:20 |
| 10 | 10.3 option | Catch & Release Tips (Art of Catch & Release) | 5:16 |
| 10 | 10.3 option | Fishing Tips | 1:42 |

| Enrichment | Time |
|---------------------------------------|-------|
| Mississippi River Maintenance Man | 5:57 |
| Missouri River Relief | 6:51 |
| Crappie Radio Tagged | 4:28 |
| Are You Still There? (Chicken Turtle) | 7:37 |
| Our Corner of the World | 10:46 |
| Ozark Mountain Paddlers | 4:45 |

| Other Files | |
|-------------------------|--------------------|
| CMAE Student Guide pdfs | |
| CMAE Teacher Guide pdfs | |
| Dichotomous Key Mazes | |
| Chapter | Title |
| 4 | Fish |
| 7 8 9 | Macroinvertebrates |
| 9 | Duck wings |

Glossary

Abiotic—nonliving; not derived from living organisms; inorganic

Acid rain—rain or other precipitation containing a high amount of acidity

Adaptation—a behavior or trait that increases a species' chance of survival in a specific environment; the process of adapting

Anaerobic—occurring or living in the absence of oxygen

Angler—fisherman, especially one fishing for pleasure using a hook and line

Aquatic ecosystem—an ecosystem organized around a body of water

Aquatic organism—any living thing that is part of an aquatic ecosystem

Aquatic resource—water and all things that live in or around water

Aquifer—an underground layer of sand, gravel or rock that hold water in pores or crevices

Atmosphere—the gaseous envelope surrounding the earth; the air

Biodiversity—the number and variety of living things in an environment

Biosphere—the part of the world in which life can exist; living organisms and their environment

Biotic—of or having to do with life or living organisms; organic

Buffer—to serve as a protective barrier to reduce or absorb the impact of other influences; something that buffers

Carrying capacity—an ecosystem's resource limit; the maximum number of individuals in a population that the ecosystem can support

Channel—the part of the stream where water collects to flow downstream, including the streambed, gravel bars and stream banks

Clean Water Act—primary federal law in the United States governing water pollution, first passed by Congress in 1972

Collector—an aquatic invertebrate that feeds on fine material; examples include caddisfly larvae and mayfly nymphs

Community—a group of plants and animals living and interacting with one another in a particular place

Compete—the act of actively seeking after and using an environmental resource (such as food) in limited supply by two or more plants or animals or kinds of plants or animals

Condense—to change a gas or vapor to liquid

Conservation—the wise use of natural resources such that their use is sustainable long term; includes protection, preservation, management, restoration and harvest of natural resources; prevents exploitation, pollution, destruction, neglect and waste of natural resources

Consumer—an organism that feeds on other organisms in a food chain

Current—the part of a body of water continuously moving in a certain direction

Decompose—to decay or rot; to break down or separate into smaller or simpler components

Decomposer—an organism such as a bacterium or fungus that feeds on and breaks down dead plant or animal matter, making essential components available to plants and other organisms in the ecosystem

Detritus—loose material that results from natural breakdown; material in the early stages of decay

Dissolved oxygen—oxygen gas absorbed by and mixed into water

Ecosystem—a community of organisms together with their physical environment and the relationships between them

Energy pyramid—a graphical representation designed to show the relationship between energy and trophic levels of a given ecosystem

Erosion—the gradual wearing away of land surface materials, especially rocks, sediments and soils, by the action of water, wind or ice; usually includes the movement of such materials from their original location

Ethical—following the rules of good conduct governing behavior of an individual or group

Evaporation—to change from a liquid state into vapor

Filter feeder—an aquatic animal, such as a mussel or some species of fish, that feeds by filtering tiny organisms or fine particles of organic matter from water that passes through it

Fin—a wing- or paddle-like part of a fish used for propelling, steering, or balancing in the water

First-order stream—a small stream with no tributaries coming into it

Floodplain—the flat land on both sides of a stream, into which the stream's extra water spreads during a flood

Food chain—a series of plants and animals linked by their feeding relationships and showing the transfer of food energy from one organism to another

Food web—many interconnected food chains within an ecological community

Geosphere—the solid part of the earth consisting of the crust and outer mantle

Gill—a respiratory organ that enables aquatic animals to take oxygen from water and to excrete carbon dioxide

Grazer—an aquatic invertebrate such as a snail or water penny that eats aquatic plants, especially algae growing on surfaces

Groundwater—water that flows or collects beneath the earth's surface in saturated soil or aquifers

Habitat—the natural environment in which an organism normally lives, including the surroundings and other physical conditions needed to sustain it

Headwaters—the high ground where precipitation first collects and flows downhill in tiny trickles too small to create a permanent channel

Hydrosphere—all of the Earth's water, including surface water, groundwater and water vapor

Inorganic—composed of matter that does not come from plants or animals either dead or alive; abiotic

Intermittent stream—a stream that flows, dries up, and flows again at different times of the year

Invasive species—a species that has been introduced by human action to a location where it did not previously occur naturally, has become capable of establishing a breeding population in the new location without further intervention by humans and has spread widely throughout the new location

Invertebrate—any animal without a spinal column; for example, insects, worms, molluscs and crustaceans

Lake—a large body of standing water

Lateral line—an organ running lengthwise down the sides of fish, used for detecting vibrations and pressure changes

Marsh—a wetland dominated by reeds and other grass-like plants

Natural selection—the natural process in which those organisms best adapted to the conditions under which they live survive and poorly adapted forms are eliminated

Natural resource—something that is found in nature that is useful to humans

Niche—the function, position, or role of a species within an ecosystem

Non-point pollution—water pollution that comes from a combination of many sources rather than a single outlet

Organic—composed of matter that comes from plants or animals either dead or alive; biotic

Oxbow lake—crescent-shaped lake formed when a bend of a stream is cut off from the main channel

Perennial stream—a stream that flows for most or all of the year

Physiographic—pertaining to physical geography; relating to the surface features of terrain

Plankton—microscopic free-floating plant- or animal-like organisms

Point-source pollution—water pollution that comes from a single source or outlet

Pollution—the contamination of air, water, or soil by substances that are harmful to living organisms, especially environmental contamination with man-made waste; also the harmful substances themselves

Pond—a body of standing water small enough that sunlight can reach the bottom across the entire diameter

Pond succession—the natural process by which sediment and organic material gradually replace the water volume of a pond ultimately resulting in the area becoming dry land

Pool—an area of deeper, slower-moving water in a stream

Population—a group of individuals of the same species occupying a specific area

Precipitation—a form of water such as rain, snow or sleet that condenses from the atmosphere and falls to Earth's surface

Predator—an animal that lives by capturing and eating other animals

Prey—an animal that is eaten by a predator

Producer—an organism that is able to produce its own food from non-living materials and which serves as a food source for other organisms in a food chain; green plants

Recharge—water that soaks into and refills an aquifer

Reservoir—an artificial lake used to store water

Riffle—an area of shallow, faster-flowing water in a stream

Riparian zone—land next to the stream, starting at the top of the bank, with heavy plant cover on either side

River—a large stream

Runoff—precipitation not absorbed by soil

Saturated—soaked with moisture; having no pores or spaces not filled with water

Scale—any of the small, stiff, flat plates that form the outer body covering of most fish

Sediment—silt, sand, rocks, and other matter carried and deposited by moving water

Shredder—an aquatic invertebrate such as a stonefly nymph that feeds by cutting and tearing organic matter

Slough—a backwater or secondary channel of a stream

Sport fisherman—an angler who catches fish for personal use or recreation, rather than to make a living

Stream—a body of flowing water

Stream bank—the shoulder-like sides of the stream channel from the water's edge to the higher ground nearby

Streambed—the bottom of the stream channel

Surface water—precipitation that runs off the land surface

Swamp—a wetland in which trees or woody shrubs predominate

Swim bladder—an air-filled sac near the spinal column in many fishes that helps maintain buoyancy

Transpiration—the passage of water through a plant to the atmosphere

Tributary—a stream that flows into a larger stream or other body of water

Trophic level—a group of organisms that occupy the same position in a food chain; each step of an energy pyramid

Water cycle—the natural process of evaporation and condensation, driven by solar energy and gravity, that distributes the earth's water as it evaporates from bodies of water, condenses, precipitates and returns to those bodies of water

Water pollution—an excess of natural or man-made substances in a body of water; especially, the contamination of water by substances that are harmful to living things

Water quality—the fitness of a water source for a given use, such as drinking, fishing or swimming

Watershed—all the land from which water drains into a specific body of water

Watershed address—the watershed, sub-watershed and sub-sub-watershed that includes a particular location

Wetland—a low-lying area where the soil is saturated with water

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Stream Team Inventory Guide
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Wetland Habitat Pack

Articles

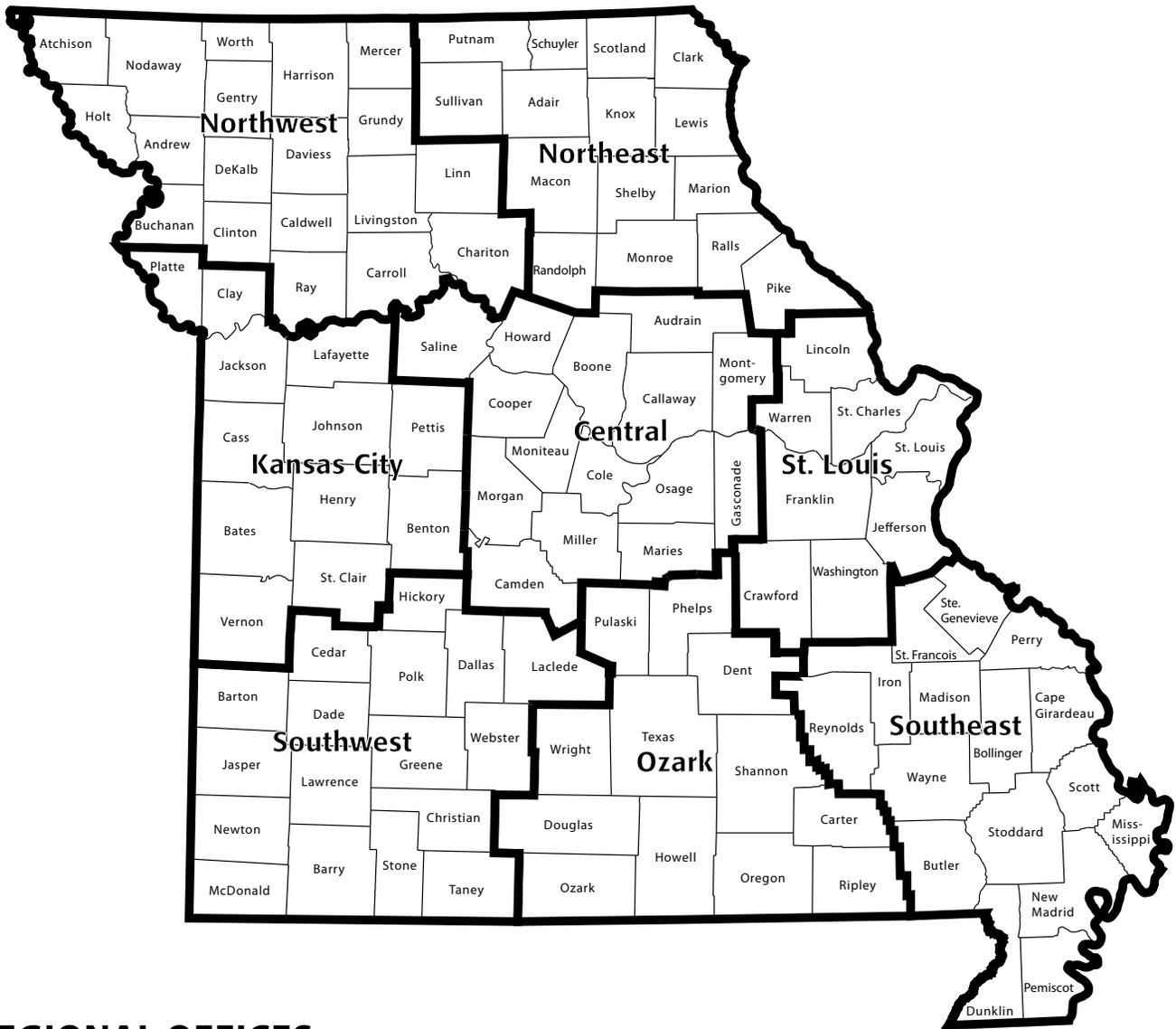
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Projects, Programs and Web sites

Bryant Creek Watershed Project, watersheds.org
Council of State Science Supervisors, csss-science.org/safety.shtml
ecoMentors, ecomentors.ca
Missouri Department of Elementary and Secondary Education, dese.mo.gov/
Missouri Stream Team, mostreamteam.org
Project WET: Curriculum and Activity Guide by The Watercourse and the Council for Environmental Education
Project WILD Aquatic K-12 Curriculum and Activity Guide by Project Wild and the Council for Environmental
Education
ScienceAware, scienceaware.com/genlabsf.htm
U.S. Environmental Protection Agency, epa.gov/safewater/kids/teachers_4-8.html
U.S. Geological Survey Water Science for Schools, ga.water.usgs.gov/edu/



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