Riparian Track & Sign

Mammal Evidence Along Running Waters

A Curriculum Unit of the Program
Monitoring the White River (MWR)

Developed by
The White River Partnership
and Ecotone Education

Written by Jennifer Guarino
Illustrated by Susan Sawyer

Second Edition, May 18, 2014

Riparian Track & Sign
Mammal Evidence Along Running Waters

Table of Contents

Riparian Track & Sign Unit Summary

During winter, we retreat inside to find shelter from our blustery weather. Animals, too, must accommodate the season; some leave for warmer climates, some sleep through the harsh conditions, and some continue their activities, leaving behind evidence of their passing. Tracks on the ground, remains of eaten materials, teeth marks on trees – all become records of busy animal lives.

With their rich natural resources, *riparian zones* attract a variety of mammals and offer lots of opportunities for wildlife detective work. They are important natural systems that weave the river and land together for the benefit of both.

The timeperiod from early winter to late winter offers good opportunities for observing mammal Track and sign. Riparian zones that have thick summer vegetation are easier to access in winter, when plants have died back for the season. Leaf-less trees give us a broad view of the landscape, and winter snow and mud record many ground-based activities.

NEXT GENERATION SCIENCE STANDARDS ALIGNMENT
WITH RIPARIAN TRACK & SIGN MODULE

Grade Level	Next Generation Science Standards	Disciplinary Core Ideas	Performance Expectations	Student Assessment Activities
3rd grade	**3-LS4: Biological Evolution: Unity and Diversity**	**LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.	**3-LS4-3** Construct an argument with evidence that in a particular habitat, some organisms can survive well, some survive less well, and some cannot survive at all.	**Riparian Food Web** (especially the comparison of a winter food web with a summer food web)
5th grade	**5-LS2: Ecosystems: Interactions, Energy, and Dynamics**	**LS2.A: Interdependent Relationships in Ecosystems** … Organisms are related in food webs in which some animals eat plants and other animals eat the animals that eat plants… Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life….	**5-LS2-1** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	**Riparian Food Web** **Riparian Track & Sign Fieldwork** **Riparian Track & Sign Posters**
6th – 8th grades (Middle School)	**MS-LS2: Ecosystems: Interactions, Energy, and Dynamics**	**LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with non-living factors.	**MS-LS2-1** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. **MS-LS-2-2** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	**Riparian Food Web** **Riparian Track & Sign Fieldwork** **Riparian Track & Sign Posters**
		LS2.B: Cycle of Matter and Energy Transfer in Ecosystems Food webs are models that demonstrate how matter and energy are transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. ….	**MS-LS2-3** Develop a model to describe the cycling of matter and flow of energy among living and non-living parts of an ecosystem.	**Riparian Food Web**

A. SETTING THE STAGE

Monitoring the White River: A School-Based Program

Monitoring the White River (MWR) is a school-based program sponsored by the White River Partnership, a nonprofit organization, and Verdana Ventures, an educational consulting firm. MWR uses a teacher-directed approach to involve students in grades 3 through 12 in investigating natural components of the White River watershed to produce information that fosters the health of our shared landscape. Fieldwork methods adapted from professional scientists help to address real-world issues identified by watershed stewardship projects. As such, MWR is an authentic "science to service" program.

Four **MWR units** can be tailored to address individual school goals. They are:

- ***Waterbugs*** (benthic macroinvertebrates) – indicators of river health and water quality
- ***Crayfish*** – key members of river and riparian food webs that may be impacted by the arrival of invasive crayfish species
- ***Riparian Trees*** – riparian trees planted to prevent erosion and improve river health
- ***Riparian Track & Sign*** – evidence of wildlife activities along river corridors

Each of these units can be tailored to meet the specific goals of schools and their districts. Whenever possible, we promote collaborative programming among grades within a school and between various schools.

Participating schools are invited to borrow an *MWR Teaching Kit* for each unit, which includes all or most of the supplies needed for the activities described in the unit.

The White River Partnership (WRP) is a non-profit organization that was created in 1996 by local community members who were concerned about the long-term health and sustainability of the White River and its watershed. That same year, the Partnership organized a series of public forums to help identify community concerns about the watershed. Streambank erosion, water quality, declining fish populations, and public access to the river were the major concerns. The WRP addressed these concerns through the implementation of programs. Currently, the programs focus on monitoring the health of the watershed through various assessments, restoring and protecting the river watershed, and promoting education and long-term stewardship. The WRP encourages local communities, businesses, and organizations to become involved, and also provides public information on a range of issues relating to the watershed.

Verdana Ventures LLC (VV) is an educational consulting company based in Randolph, VT, focused on sustainable development and environmental literacy. VV partners with local non-profit organizations (such as the WRP) to offer watershed education

programming, focused on student fieldwork, to schools in central Vermont. VV has conducted school and community programs in the U.S and Asia.

The White River Watershed

The uneven **topography** of the land creates natural basins that drain rain, snowmelt, springs, and groundwater into a water body at the lowest elevation, such as a stream, river, wetland, pond, or lake. These basins are called **watersheds.** The boundary, or divide, of a watershed is the "rim" of the basin, which can be drawn by connecting the highest points of land around it. Streams and rivers function as the "arteries" of the watershed by carrying water downhill.

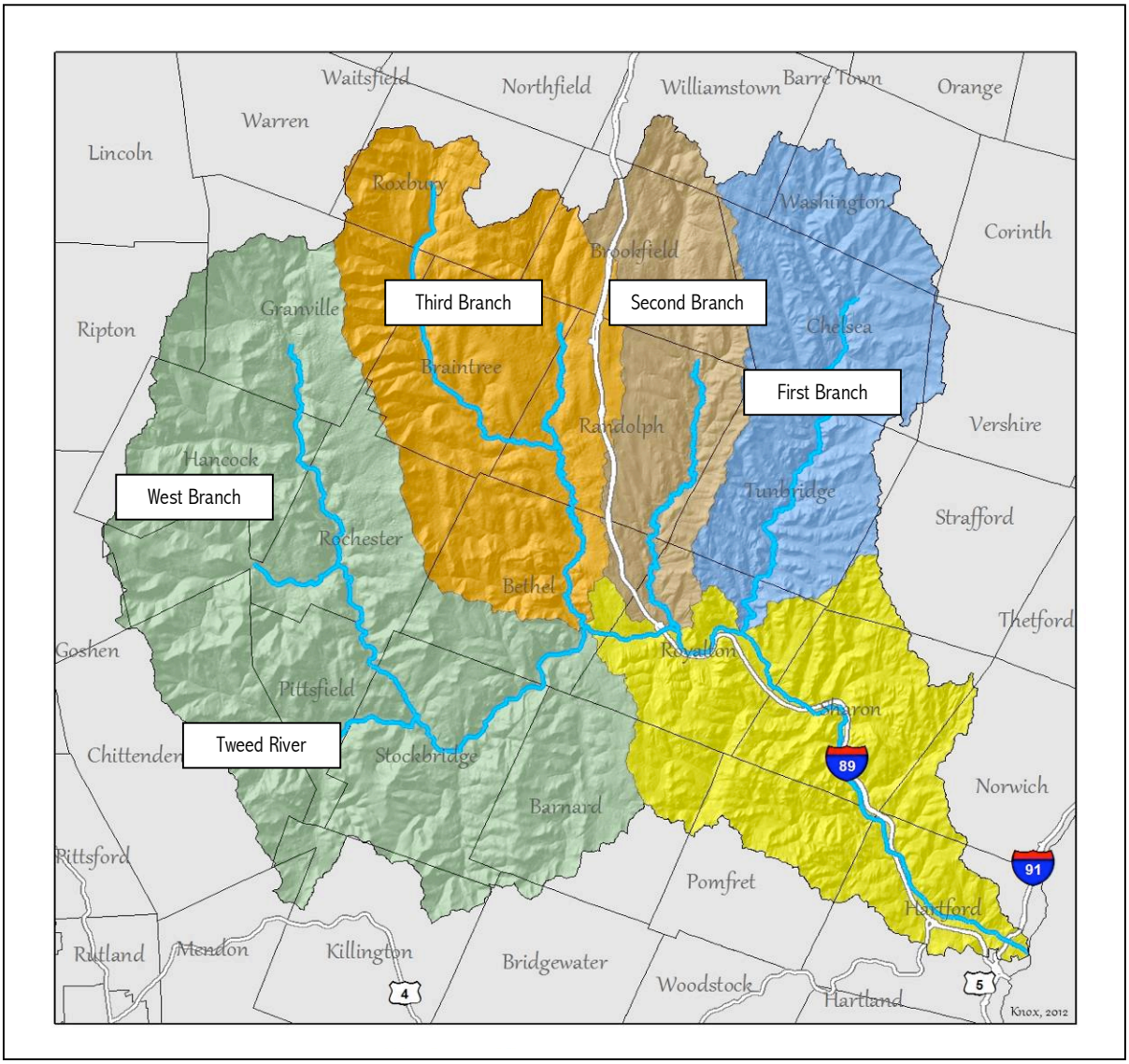
The White River watershed encompasses 710 square miles in central Vermont, draining portions of 5 counties (Addision, Orange, Rutland, Washington, and Windsor) and all or part of 23 towns (see map below). About 50,000 acres of the Green Mountain National Forest are contained within it. The **White River mainstem** is one of the last free-flowing rivers in Vermont. It begins in the Town of Ripton, where it flows in a southeastern manner until it merges with the Connecticut River in the Town of Hartford. The main stem is 56 miles long and has 5 major tributaries:

1. First Branch
2. Second Branch
3. Third branch
4. West Branch
5. Tweed River

The White River watershed is important both locally and nationally. The State of Vermont has implemented programs for the protection, restoration, and management of the White River in order to enhance its ecological and economic functions. It is a subset of the Connecticut River watershed, which is wholly contained by the Silvio O. Conte National Fish & Wildlife Refuge. The White River has been designated a *Special Focus Area* within this refuge because it provides a nursery and rearing habitat for juvenile Atlantic salmon and spawning habitat for the adults.

The **Connecticut River** begins in northern New Hampshire and travels south 410 miles, forming much of the border between Vermont and New Hampshire, then coursing through Massachusetts and Connecticut before emptying into the Atlantic Ocean at Long Island Sound. On its way to the ocean, the Connecticut River collects the waters of many other rivers that drain forests, wetlands, farmlands, towns, and cities while providing food, power, and transportation for human communities across the region. Many animals, plants, and other organisms find habitats and water sources within its boundary. Its designation as one of 14 American Heritage Rivers protects such values as ecological diversity and cultural heritage for a significant portion of New England.

The White River Watershed and Its 5 Main Tributaries



For more information on the White River watershed, please visit the website of the White River Partnership: http://www.whiteriverpartnership.org.

Why Monitor Your River?

It is said that a river is a reflection of the land through which it flows. Water and land are interwoven to create a dynamic natural system, so monitoring a river is a good way to check the overall health of the landscape. Evidence of land and water uses shows up in river monitoring data, which can determine that a landscape is healthy or reveal that human activities are impairing it.

A healthy Vermont river generally has a variety of trees and other plants growing along its banks, lots of dissolved oxygen in its waters, and a diverse food web that includes resident aquatic organisms and terrestrial organisms that visit the river to find resources. Good river health usually correlates with high water quality, and poor river health is often indicative of poor water quality. Water quality is defined by the United States Geological Service (USGS) as follows:

> **Water quality** can be thought of as a measure of the suitability of water for a particular use based on selected physical, chemical, and biological characteristics. To determine water quality, scientists first measure and analyze characteristics of the water such as temperature, dissolved mineral content, and number of bacteria. Selected characteristics are then compared to numeric standards and guidelines to decide if the water is suitable for a particular use. (http://pubs.usgs.gov/fs/fs-027-01/)

For more information on water quality, please consult the USGS website above or the Water Quality Standards website of the United States Environmental Protection Agency (USEPA) (http://water.epa.gov/scitech/swguidance/standards/).

Monitoring and Assessments

When we *monitor* something, we assess it at regular intervals to see whether and how it is changing. Monitoring shows trends over time, which can help us to maintain a healthy condition, detect a change in condition, or improve a poor condition. Scientific *assessments* measure the status of particular components of the river system. A river monitoring program uses specific scientific assessments at regular intervals to gather information about the health of the river's ecosystem and its water quality.

River assessments fall into 3 broad categories: biological assessments, physical assessments, and chemical assessments. Each of these categories provides a particular set of water quality data, and many river monitoring programs incorporate two or all three categories. Each kind of assessment is briefly described below. Please consult other resources for more detailed information.

Biological assessments. Examples: benthic macroinvertebrates (waterbugs), crayfish, riparian wildlife Track and sign, riparian trees. These assessments measure elements of natural communities in and along a river and are contained in the four MWR units.

The composition of a river's natural communities offers a lot of information about the health of that river and its water quality. A natural community occupies a particular area because conditions, over time, are conducive to its survival. Therefore, assessments of biological communities can help to determine the overall condition of a river and its

landscape. Biological assessments conducted at regular intervals over time (biomonitoring) contribute to a useful record of the river's overall health and water quality.

In general, good river health is indicated by the following community profiles:

- a high diversity of natural species
- the presence of species that are sensitive to pollution and/or physical disturbance
- the presence of native species and the absence of invasive species

Chemical assessments. Examples: dissolved oxygen, pH, nitrates, phosphates.

Each chemical assessment measures a specific parameter of the river's chemistry at a particular moment in time. Chemical conditions are constantly changing as the water flows along, so one chemical assessment does not indicate the overall chemical condition of a river. Chemical assessments conducted at regular intervals over time (chemical monitoring) contribute to a useful record of the river's water quality.

Physical assessments. Examples: velocity, river discharge, embeddedness of the streambed.

Because the physical environment influences both water quality and river health, physical assessments are often used in conjunction with chemical and biological assessments.

Promoting Environmental Literacy

Monitoring the White River (MWR) encourages schools and communities to monitor one or more natural components in their part of the watershed to build their own knowledge base about their unique place, and then to share their knowledge with other groups across a broader area. MWR promotes environmental literacy by:

1. Connecting students to their place so that they feel invested in the well-being of their environment and their community.
2. Helping students learn how to use scientific inquiry to explore their world (see E. CULMINATING ACTIVITIES, USING THE SCIENTIFIC METHOD).
3. Helping students achieve pertinent academic standards in the Common Core and Next Generation Science Standards (see G. HELPFUL TOOLS, CRAYFISH RESOURCES).
4. Helping students understand how society uses scientific information and collaboration to make informed decisions as democratic citizens.
5. Helping students gather useful information about their place, which contributes to thoughtful river stewardship. This service learning approach builds a positive alliance between the school and its community.

The Riparian Zone

A river is a distinct ecosystem comprised of the water-covered riverbed and the channel in which the water runs. But a river is strongly influenced by the land through which it flows, especially the strip of land on either side of the channel. In turn, the land is shaped by the activities of the river. The *riparian zone* is the area of transition between the river and the land. It is an **ecotone** that provides important resources for both the river and the land along it.

A river's riparian zone is characterized by:

- periodic inundation, when a rise in water level causes the river to spill into the surrounding landscape
- vegetation that can withstand rises and falls in water level
- evidence of changes to the river's meander pattern over time (a river changes its course depending on natural and human influences, and these changes can erode soil from the riverbank or deposit new sediments to build up the riverbank)

A *healthy* riparian zone, or buffer, is characterized by:

- a wide margin of natural woody plants (trees and shrubs)
- a high diversity of native plant species
- a high diversity of wildlife species that find stable habitats along the river

In Vermont and elsewhere, many miles of riverside land have been changed by human activities, which can disrupt or destroy riparian buffers. Historically, people settled in valleys to farm the fertile soils and gain easy access to water. Dams across the rivers harnessed hydropower for growing economies, which fueled further development of industries and settlements. In more modern times, recreational facilities, like parks and athletic fields, replaced floodplain forests with monocultures of short grass.

Growing awareness of the environmental services offered by biologically diverse riparian buffers, which are summarized below, has propelled recent efforts to bring trees and shrubs back to our riverbanks.

Environmental Services of Riparian Trees

A healthy riparian buffer provides numerous environmental services to human communities including the following:

- It slows down runoff and filters out sediments and pollutants before the water reaches the river
- It regulates stream flow by absorbing excess water volume and releasing it slowly over time.
- It stabilizes the riverbanks by holding them in place with extensive root systems.

- It stabilizes the streambed by reducing the force of water as it enters the channel, thus preventing excess erosion and excess deposition of sediments.
- It improves habitat:
  - Terrestrial animals find shelter, terrestrial and aquatic food sources, water, and safe travel corridors along the river.
  - Aquatic animals benefit from the cooling effect of tree shade, the input of plant parts which feed the river's food web, and the cover they find in woody debris that has fallen into the river.
- It enhances recreational opportunities, such as hiking, swimming, and canoing.
- It improves flood resiliency by absorbing floodwaters, receiving their load of sediments, and reducing the tremendous force of rapidly moving waters. Riparian buffers are a critical part of the floodplain system, which nature designed to accommodate and moderate the inevitable floods in river corridors.

For more information on riparian buffers, please see the publication *An Introduction to Riparian Buffers* by the Connecticut River Joint Commissions (CRJC) at http://www.crjc.org/buffers/Introduction.pdf.

B. UNIT BACKGROUND: MAMMAL EVIDENCE ALONG RUNNING WATERS

As an ecotone between upland and aquatic ecosystems, the riparian zone offers especially rich habitat resources for wildlife. Because of this, riparian zones are excellent places to discover animal evidence - especially in the winter, when vegetation is largely absent and snow records many animal activities.

Animal evidence can be tracks – footprints left behind as animals move through an area – or "sign" – all other kinds of animal evidence, such as holes in trees, teeth marks on trees, and food remains. All kinds of animals - mammals, birds, amphibians, and reptiles - find good habitats in riparian zones. This unit focuses on mammals because their evidence is both obvious and exciting, and many of them are active through the winter.

As students gain an understanding of the presence and activities of the mammals with which they share their riparian landscape, they learn more about the special features of their place. As they develop an awareness of how these mammals interact with - and influence - the landscape, they enhance their understanding of how natural systems work.

The Riparian Track & Sign Inquiry Process

The Riparian Track & Sign Unit follows an inquiry process that asks students a series of questions to help them determine which mammals share their riparian landscape. This inquiry process includes the steps used by a journalist to write an article, but our steps occur in a different order. They are: *Where, How, What, Who, When, and Why*. The steps of this process are outlined below. (Note: The Riparian Track & Sign Slideshow follows this sequence to introduce the unit.)

Steps of the Track & Sign Inquiry Process

Habitat	***1. Where?***	***Where*** did you find the tracks and/or sign? What kinds of **habitat** are present? Observing habitat types can help you to narrow down the possible animal species that might be found there. Possible riparian habitats include: • forests: deciduous (hardwood), coniferous (evergreen), or a "mixed forest" • wetlands: marsh (with nonwoody plants), swamp (with woody plants), vernal pool • openings: hay field, livestock pasture, lawn • a blend of two or more such habitats
Clues to the Mammal	***2. How?***	***How*** did the animal move? Because of its specific anatomy and habits, each kind of animal uses a particular set of movements. Consider: • track or gait pattern; four general patterns are recognized – walker/trotter, hopper, bounder, and waddler • direction of travel; the placement of front and back feet, as well as toes and claws, provide directional clues • "starts and stops"; did the animal fly down to the ground and/or take off again? Did the animal jump out of a tree or walk/run/leap up to it and then climb it? • speed; can you tell how slow or fast the animal was moving by the distance between sets of tracks?
	3. What?	***What*** are the details of the track? Consider: • paw or hoof? • number and shape of toes • shape of pad(s) • whether it's a front or back track • are the claws visible? • overall size
	4. Who?	***Who*** might the track belong to? Once trackers answer questions regarding *Where, How, When,* and *What,* they are much better able to determine *Who* was there. Families of Vermont mammals that frequent riparian zones, and the species within these families that are typically found here, include: • Canidae: domestic dog, coyote, red fox, gray fox • Felidae: domestic cat, bobcat • Mustelidae: otter, mink, fisher, short-tail weasel (ermine), long-tail weasel • Mephitidae: striped skunk • Castoridae: beaver (only one species in Vermont) • Sciuridae: gray squirrel, red squirrel, chipmunk • Cricetidae: muskrat, mouse, vole • Procyonidae: raccoon (only one species in Vermont) • Cervidae: white-tail deer, moose
The Mammal in Its Habitat	***5. When?***	***When*** did the animal move through the area? The timing of weather events can provide useful clues. For example, if the track is filled with snow, think about when

		the snow fell; the track was left before that event. If the track was deformed by a melt and a refreeze, think about when that occurred.
	6. Why?	***Why*** was the animal there? Wild animals are deliberate in their movements because they cannot afford to waste their energy. This is especially true in winter, when cold weather burns more calories and food is hard to find. The reasons that animals may be found along a river include: • hunting for prey (carnivores and omnivores) • gathering plant parts for food (herbivores and omnivores) • finding water • finding shelter from the weather • finding cover from predators • finding building materials (beavers and muskrats) • finding a mate • traveling from one place to another (riparian zones provide relatively easy travel routes) Asking the question "*Why* was the animal there?" encourages students to think of the animal in the context of its ecosystem. Through observations of possible habitat features, students consider ways that each species of animal makes its living in this riparian zone. They begin to realize that their river's riparian zone is a natural system with interacting parts. The physical environment, weather conditions, the plant community, and the animals that are drawn here to meet their survival needs are all part of a dynamic interplay. If a change occurs in one element of this system, the animal species that live here must adjust their habits or move to a more suitable area.

Systems, Change, and Environmental Literacy

Like natural systems, human systems – towns, schools, businesses, economies, families – are composed of interacting parts that inhabit a particular environment, and that interact with other systems. Like natural systems, human systems must adjust to a changing world. Healthy systems with diverse components and various strategies for success can accommodate significant change while remaining stable and functional. Indeed, change can encourage adaptation or creative problem-solving that can lead to greater well-being.

As humans face a host of changes in our social, economic, political, and natural environments, an understanding of how systems work can create a solid foundation from which we can make informed decisions as democratic citizens. This learning process is the goal of environmental literacy. Please see **G. HELPFUL TOOLS, RESOURCES** to learn more about environmental literacy.

C. CLASSROOM ACTIVITIES

Riparian Track & Sign Slideshow

Materials • Riparian Track & Sign PowerPoint Slideshow (obtain from WRP) • Riparian Track & Sign Slideshow Handout (obtain from WRP) • computer • projector or smart board	**Set-Up:** Prepare PowerPoint slideshow
	Timeframe: 50 min

Overview:

This slideshow describes the river's riparian zone as a rich place to find mammal evidence, introduces students to Track and sign, and discusses why mammals might be found along a river. It uses an Inquiry Process (see B. UNIT BACKGROUND) to help students understand these concepts by asking *Where, How, What, Who, When,* and *Why.*

Instructions:

Show the slides to students, using the Notes associated with each slide.

Please see the RIPARIAN TRACK & SIGN POWERPOINT HANDOUT in G. Helpful Tools for reference.

Sorting Tracks

Materials • copies of *Track Cards, Sorting Tracks Activity*, cut apart; 3 sets per team of students • envelopes, 3 per team • copies of the *Splitter Sheet*, 1 per team • flipchart sheets, 1 per team • markers • pencils or pens	**Set-Up:** • Cut apart *Tracks;* place one set of twelve tracks into envelope labeled "Level 1", another set of twelve into an envelope labeled "Level 2" and the final set into an envelope labeled "Level 3". Do this for each team. • Copy the template from the *Splitter Sheet* onto large flipchart paper; make a copy for each team **Timeframe:** 40 min

Overview

The process of learning tracks involves making observations about specific details in each track. Because many animals make very similar tracks, students must observe fine details to build identification skills.

This activity is based on the concept of the *dichotomous key* in the study of taxonomy, in which a set of organisms is split in half and put into one group or the other based on similarities between members of that group. Then each half is split in half again, and so on until you have separated all organisms in that set.

In this activity, students will split a set of twelve tracks 3 times (into Level 1, then Level 2, and then Level 3 – see Figure 1 below). When they are done, they will have divided the twelve tracks into several subgroups, each of which contains tracks with similar characteristics.

Instructions

1. Review the steps of the *Track & Sign Inquiry Process* with students (see Figure 1 below, and B. UNIT BACKGROUND for more information). Tell them that this activity focuses on the question *What?* to help them learn to make careful observations of each track, and build skills that will help them to identify the tracks later on. Emphasize that this activity is not focused on *Who* – the identity of the mammal that made each track.
2. Explain that each team of students will receive 3 sets of envelopes – marked Level 1, Level 2, and Level 3. Each envelope contains the same twelve track cards. Their job is to work with their team members to make a series of "splits" – that is, to organize the tracks into two groups by like characteristics, and to do this a total of 3 times.

Figure 1.
Summary of the Riparian Track & Sign Inquiry Process

Habitat	*1. Where?*
Clues to the Mammal	*2. How?*
	3. What?
	4. Who?
The Mammal in Its Habitat	*5. When?*
	6. Why?

Figure 2.
Nine envelopes for 3 small groups. Each group gets a Level 1 envelope, a Level 2 envelope, and a Level 3 envelope. All envelopes have the same twelve tracks.

Sam's group	Leah's group	Pat's group
Level 1	Level 1	Level 1
Level 2	Level 2	Level 2
Level 3	Level 3	Level 3

3. Divide the class into small teams with 3 or 4 students each. Give each team the 3 track card envelopes. Ask them to spread out the tracks from Level 1 on a table or the floor. Have them work together to decide on a way to split the 12 tracks into 2 groups, each of which includes tracks with something in common. Have them place one group of tracks into the **Group A box in Level 1** on their large (flipchart) *Splitter Sheet* and the other group of tracks into the **Group B box in Level 1**.

   Notes:

   1. *Since there are sometimes several ways to split a group, team members must discuss their ideas for splitting the tracks and decide on one approach for their team.*
   2. *Tell students not to use size to group or separate tracks (example: big ones here, small ones there) since the tracks are not drawn to scale.*

4. Ask teams to write words or phrases in each box on their copy of the small (8.5 x 11 inch) *Splitter Sheet* that describe common characteristics of the tracks in that box. Have teams leave their Level 1 tracks in place on the large *Splitter Sheet*.
5. Have teams remove the twelve tracks from their **Level 2** envelope. Referring to the placement of their Level 1 tracks, ask teams to split the Level 2 tracks in Group A into **Group A-1 and Group A-2** on the large *Splitter Sheet*. Then have them split **Level 2** tracks in Group B into **Group B-1 and Group B-2**.
6. Ask teams to write words or phrases in each box that describe common characteristics of the tracks in that box. Have teams leave their Level 2 tracks in place on the small *Splitter Sheet.*
7. After completing Level 2, have teams complete one more split for **Level 3: Group A-1 tracks** get split into **Group A-1-1** and **Group A-1-2**, and so on.
8. When all teams are done, have each team share its classification system with the whole class. Different teams may have arrived at different classification systems, which is fine since there are often several ways to classify parts of a system.
6. Explain that *taxonomy* is the science of organizing organisms into groups that share like characteristics. Taxonomists sometimes have different ideas about how to classify certain organisms, and occasionally organisms are regrouped. For instance, skunks have traditionally been considered a subfamily within the family Mustelidae (weasels). Recently, taxonomists have put them into a separate family called Mephitidae.[1]
7. Ask students:
    a. How can taxonomy help us to identify animal tracks? (By helping us to see differences between similar tracks).
    b. How can taxonomy help us to see how certain animals are related? (Related animals have similar tracks; example: red fox and gray fox.)

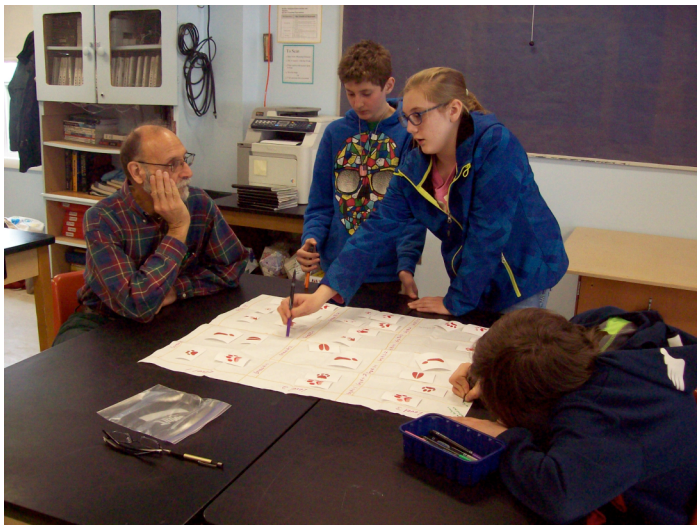
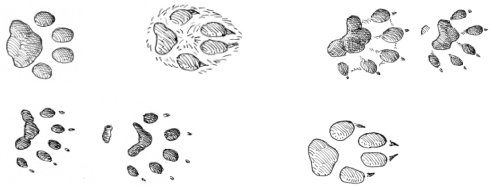
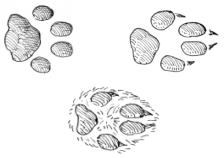
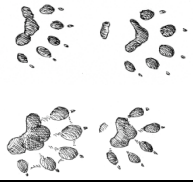


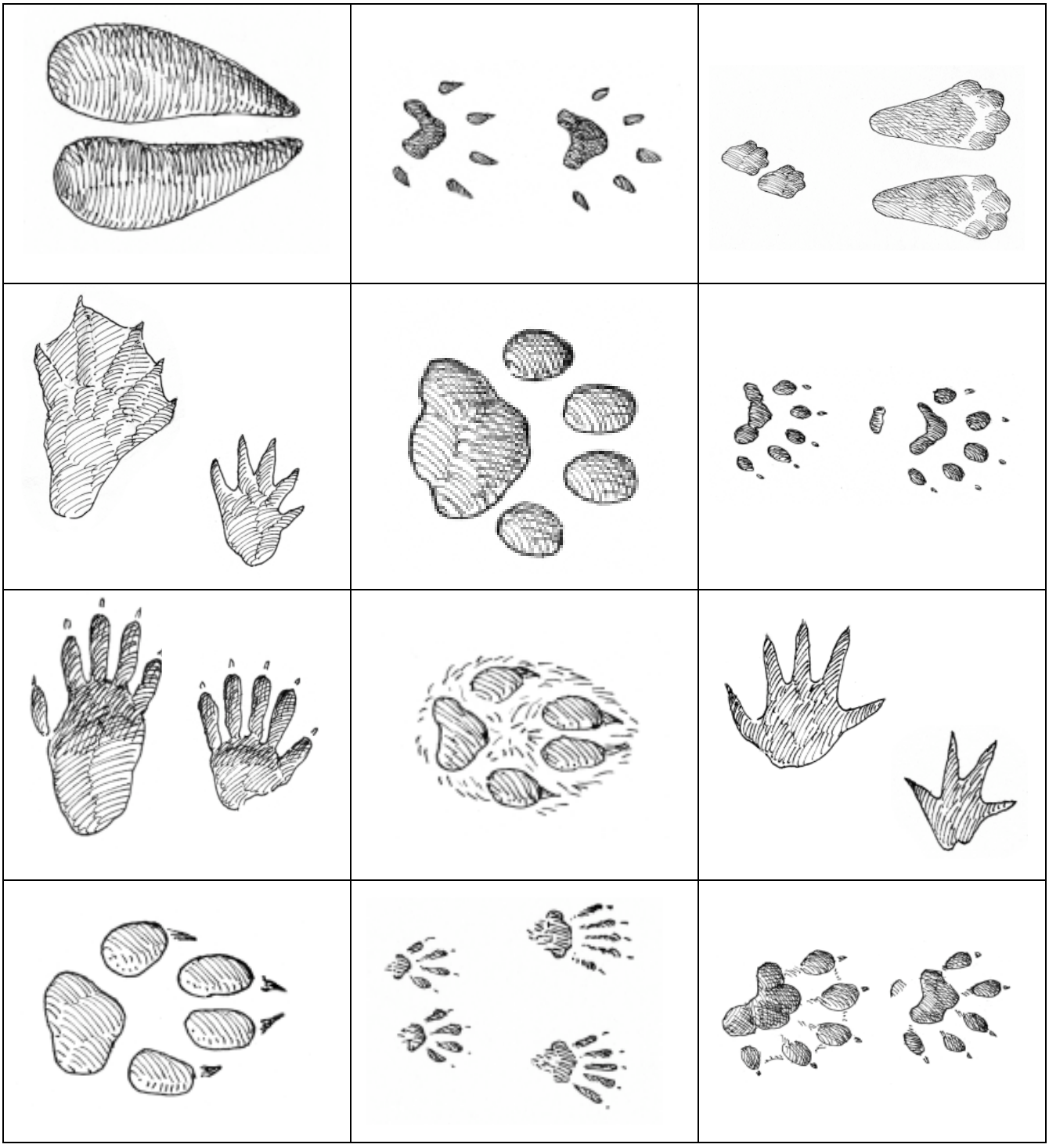
Figure 3.
A student explains her team's classification system to her teacher.

[1] University of Michigan, Museum of Zoology (http://animaldiversity.ummz.umich.edu/)

Figure 4. One way to split the tracks into Level 1 and Level 2.

<table>
<tr><td rowspan="2">Level 1</td><td colspan="2">Group A</td><td colspan="2">Group B</td></tr>
<tr><td colspan="2">  </td><td colspan="2">  </td></tr>
<tr><td rowspan="2">Level 2</td><td>Group A-1</td><td>Group A-2</td><td>Group B-1</td><td>Group B-2</td></tr>
<tr><td>  </td><td>  </td><td>  </td><td>[no tracks in this box]</td></tr>
</table>

TRACK CARDS
SORTING TRACKS ACTIVITY



SPLITTER SHEET

SORTING TRACKS ACTIVITY

(Copy this template (this page and the next page) onto large flipchart sheets of paper)

Names: _____ Date: _____

Draw the table below onto flipchart sheets. Use one set of 12 tracks for each Level (1, 2, and 3).
At each Level, divide your tracks into two Groups (example: Level 1 tracks get split into Group A or Group B). Then write descriptors for each group of tracks.

LEVEL 1	**Group A**		**Group B**	
	Descriptors:		Descriptors:	
LEVEL 2	**Group A-1**	**Group A-2**	**Group B-1**	**Group B-2**
	Descriptors:	Descriptors:	Descriptors:	Descriptors:

LEVEL 3	**Group A-1-1**	**Group A-1-1**	**Group A-2-1**	**Group A-2-2**	**Group B-1-1**	**Group B-1-2**	**Group B-2-1**	**Group B-2-2**
	Descriptors:	Descriptors:	Descriptors:	Descriptors:	Descriptors:	Descriptors:	Descriptors:	Descriptors:

Learning Student Fieldwork

Materials (for learning fieldwork and conducting fieldwork)	**Set-Up:**
• copies of *Riparian Track & Sign Fieldwork Sheets* (below), one per student or pair of students • Track & sign fieldwork guides (such as those in the WRP Riparian Track & Sign Teaching Kit) • rulers (to measure Track and sign) • clipboards and pencils	• Review the Track & Sign Fieldwork Guidelines in C. FIELDWORK ACTIVITIES. • The day before your fieldwork session, send students home with the Student Track & Sign Fieldwork Checklist so that parents can help them arrive on the fieldwork day prepared to go outside and work comfortably.
	Timeframe: 40 min

Overview

To familiarize students with the fieldwork sheet they will complete when they go outside for fieldwork.

Instructions

1. Explain that students will go outside to explore a riparian area for mammal evidence, using their knowledge of Track and sign. They will record their data using a fieldsheet that organizes the information they collect.
2. Review the BACKGROUND: ANIMAL EVIDENCE ALONG RUNNING WATERS with students. Discuss the ways in which each step of the *Inquiry Process* can help them to discover the mammals that can be found in your riparian zone.
3. As a class, discuss the *purpose* of your fieldwork and generate a Purpose statement for the class. Each student can be encouraged to write a second, individual *Purpose* statement based on what he/she would like to gain from fieldwork. (Students will record the class *Purpose* statement and optional individual *Purpose* statement on their fieldsheet.) A possible Purpose statement for the class might be:

   To find out what kinds of mammals use our riparian zone during the winter, and investigate why they are there.

3. Give a copy of the field sheet to each student and review it with the class, answering questions as you go along. Have students record the class *Purpose* statement (and optional individual *Purpose* statement) in the space provided.

   Important ideas to discuss:

   - Information about your fieldwork site can allow comparisons from one visit to the next and encourage other people to visit the area in the future.
   - Periodic assessments conducted regularly over time (monitoring) show important trends in mammal populations and movements in your riparian zone.

- Weather conditions can influence activity levels of animals, whether tracks are left behind, and the ways in which tracks may change over a series of days or weeks. Record weather data carefully.

D. FIELDWORK ACTIVITIES

Track & Sign Fieldwork Guidelines

Before your students' fieldwork day:

1. Choose a fieldwork site in a local riparian zone that:
   - can be easily accessed by a group of students during the school day (either on foot, by car, or by bus)
   - has healthy woody vegetation (the more plant-diverse, the better)
   - offers space for a group of students to move around and work comfortably
   - is a safe distance away from the ice and water of the river.

2. Schedule your fieldwork date and time and make arrangements with the school for students to leave. If the fieldwork site is relatively close, 1.5 hours is usually adequate to cover indoor preparations (getting dressed for outside work, gathering supplies, etc.), traveling to the site, doing fieldwork, and traveling back to the school. Two hours is better.

3. Arrange transportation and line up adult chaperones. We recommend 1 adult per 5 students (less adults for high school students).

4. Develop a plan to evacuate students from the fieldwork site quickly in the event of an emergency. Consider:
   - how to get students' attention right away (a whistle would be a good tool for this)
   - how to move one or more students out of the site and back to safety quickly (if you arrived on a bus, will it wait for you or come back when you are done? if you are on foot, how can you move a student in an emergency?)
   - how to use the other adult chaperones effectively to help organize students and make decisions
   - how you will notify the school of the emergency (do you have a cell phone? does it have reception at your fieldwork site? is there another phone nearby?)

5. Tell students how to dress and prepare for a productive fieldwork session. On the day before your fieldwork session, hand out the **Student Track & Sign Fieldwork Checklist** (below) and ask them to go over it with their parent.

On the day of fieldwork:

1. Have students gather general fieldwork supplies, including:
   - a clipboard and pencil
   - a ruler
   - a backpack (optional but very helpful)

2. The teacher/adult leader should gather:
   - extra fieldwork sheets and pencils (students are very creative at destroying fieldwork sheets and losing pencils)
   - first aid kit
   - whistle (optional, but it really gets their attention!)

3. Have students get ready for fieldwork at least 15 minutes before your class leaves the school, including visiting the bathrooms.

For more information,

please see RIVER FIELDWORK SUPPLIES & SAFETY PLANNING in F. Helfpul Tools

After fieldwork is completed,

please refer to E. CULMINATING ACTIVITIES to conclude this project.

Student Track & Sign Fieldwork Checklist

Students:

Please share this Checklist with your parents the day before your fieldwork session at school. This will help you to come prepared to have fun and to learn outside!

- ❒ layers of clothing that you can take off if you get too warm outside (a shirt plus a sweater or fleece layer)
- ❒ winter jacket (waterproof is best)
- ❒ snowpants
- ❒ winter hat
- ❒ winter mittens or gloves
- ❒ warm socks (wool or polyester are better than cotton, which gets very cold if it gets wet)
- ❒ warm winter boots (waterproof are best)
- ❒ water bottle (even in the winter, we need water when we're outside)
- ❒ backpack (to hold any layers that you remove, your water bottle, etc.)
- ❒ the night before: a good night's rest!
- ❒ that morning: a hearty breakfast! (cold weather and lots of walking will make you hungrier than usual)

RIPARIAN TRACK & SIGN STUDENT FIELD SHEETS

(Illustrations on these field sheets are used with permission from Lynn Levine, www.heartwoodpress.com)

Name(s): _____

Date: _____ Grade: _____

Teacher: _____ School: _____

Town: _____

If possible, take photographs to document the tracks and signs you find.

Purpose of the Fieldwork:
Materials:

1. Fieldwork Site (name it): _____	
Directions to the site:	
Description of the site:	
Weather Now:	**Weather in the last 24 hours:**
❒ snow	❒ snow
❒ rain	❒ rain
❒ wind	❒ wind
❒ below freezing	❒ freeze to melt
❒ above freezing	❒ melt to freeze

Continued next page

2. Habitat Features — *Where?*

Vegetation

- ❒ shrubs
- ❒ living trees
- ❒ dead trees (snags)
- ❒ logs on the ground
- ❒ non-woody plants (wildflowers, grass, etc.)

Water Sources

- ❒ running water
- ❒ still water
- ❒ seep

Food Sources

- ❒ prey species; list if known:

  _____

  _____

  _____

  _____

  _____
- ❒ seeds
- ❒ berries
- ❒ buds and twigs
- ❒ bark

Shelter

- ❒ holes in the ground
- ❒ holes in trees
- ❒ shrubs with closed canopy
- ❒ trees with closed canopy

Travel Routes

- ❒ ice shelf, flat bank along river
- ❒ paths through riparian plants
- ❒ paths down to river
- ❒ ice bridge across river

3. Patterns & Tracks — *How? What? Who? When?*

Pattern	✓ if present	Kind of Track
Walker/Trotter 	❒	Dog family (dog, coyote, fox) When? (estimate) ❒ today ❒ yesterday ❒ earlier
	❒	Cat family (cat, bobcat, lynx) When? (estimate) ❒ today ❒ yesterday ❒ earlier
	❒	Deer or Moose When? (estimate) ❒ today ❒ yesterday ❒ earlier

Hopper 	❒ Snowshoe hare or Rabbit When? (estimate) ❒ today ❒ yesterday ❒ earlier
	❒ Squirrel or Chipmunk When? (estimate) ❒ today ❒ yesterday ❒ earlier
	❒ Mouse, Vole, or Shrew When? (estimate) ❒ today ❒ yesterday ❒ earlier
Bounder 	❒ Weasel family (short-tail weasel, long-tail weasel, mink, fisher, otter) When? (estimate) ❒ today ❒ yesterday ❒ earlier
Waddler 	❒ Bear When? (estimate) ❒ today ❒ yesterday ❒ earlier
	❒ Raccoon When? (estimate) ❒ today ❒ yesterday ❒ earlier
	❒ Beaver When? (estimate) ❒ today ❒ yesterday ❒ earlier
	❒ Muskrat When? (estimate) ❒ today ❒ yesterday ❒ earlier
	❒ Other _____ When? (estimate) ❒ today ❒ yesterday ❒ earlier

4. Animal Signs (✓ if present)			***What?***
❒	Scat	❒	Hole in snow/ground
❒	Chewed trees or plants	❒	Hole in tree
❒	Food remains	❒	Nest in tree
❒	Dam	❒	Dig in snow/ground
❒	Claw marks on tree	❒	Slide
❒	Teeth marks on tree	❒	antler rubbings on tree
❒	Other signs _____		
❒	Other signs _____		
❒	Other signs _____		

6. Fieldwork Conclusions *Why?*

Based on your fieldwork evidence, what mammals use your fieldwork site? For each mammal for which you found evidence,

- ❒ list the mammal's family name, or species name if known (first column)
- ❒ describe the evidence that you found for it (second column)
- ❒ review ***Habitat Features*** on your fieldsheet. Think about why the mammal was there and list the resources that are available at your site during winter for this mammal (third column). Resources include food, water, shelter, possible mates, and building materials.

The first row shows an example. A great website for profiles of Vermont mammals is the Vermont Critter Curriculum: http://www.vtfishandwildlife.com/vtcritters/index.cfm. Use extra paper if needed.

Mammal Family (or **species** if known; no guesses!)	**Evidence Found**	**Resources available in winter for this mammal**
1. Raccoon	1. Tracks leading down to the river	1. Water in the river for drinking, trees for climbing to escape predators, hollow trees and logs denning, dead animals (carrion) for eating
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.

Review your *Purpose* above. Did you achieve your purpose for doing fieldwork? Explain.

E. CULMINATING ACTIVITIES

Debriefing Student Field Sheets

1. Back in the classroom after fieldwork, have students review their field sheets. Go over student observations and findings. Discuss the class *Purpose* and students' individual *Purpose* if they wrote one. Did they achieve their Purpose(s)? Finally, what conclusions can they draw about mammal activities along their riparian zone based on their fieldwork investigation?

2. The Track and sign inquiry process is based on the scientific method (see below), which completes an investigation by asking new questions. Have the class brainstorm a list of new questions that came out of their fieldwork experience. Here are some examples of questions that teachers might use to start the brainstorm:

    - We saw gray fox tracks along our riparian zone. What kinds of prey species might gray foxes find there? (could be answered with more fieldwork)
    - We saw a gray squirrel nest high in a tree. How do the squirrels get the leaves up there? (could be answered with some book/article/website research)
    - We found pileated woodpecker holes in trees. Do other animals use these holes as shelter? (could be answered with more fieldwork and/or book/article/website research)

3. Students can choose a question from the brainstormed list of new questions and follow the scientific method to investigate it.

Scientific Method

Step 1:	Ask a question that can be answered through experimentation or investigation.
Step 2:	Form a hypothesis (a proposed explanation), based on personal observations and information found on the topic.
Step 3:	Design a test (experiment or investigation) for your hypothesis.
Step 4:	Carry out your test and record your results as data or other forms of information.
Step 5:	Analyze your results, looking for patterns and trends in your data.
Step 6:	Review your original question and your hypothesis. Was your hypothesis supported by your work? If not, why not? What did you learn from this study?
Step 7:	Ask one or more new questions, based on your experience with your experiment or investigation.
Step 8:	If there is time, choose one of your new questions, form a hypothesis that may explain it, and conduct another round of experimentation/investigation (Step 1).

The scientific method can be seen as a *spiral of inquiry* that links successive cycles of experimentation/investigation. Each cycle generates new information that helps to build more knowledge over time. This is how scientists help us increase our understanding of our world.

Riparian Food Web

In this unit, we learned about track and sign for several mammals that are found in the riparian zone along our rivers and streams. These mammals and many other organisms interact through feeding pathways within a *food web,* a model that shows the feeding connections between and among organisms in an ecosystem. In this activity, students learn about the food web in a riparian ecosystem by creating one. They consider the food resources that are available to riparian mammals in the winter, when conditions are harsh and food is scarce, and in the summer, when growing plants support a much richer variety of foods.

Key food web concepts:

- An ecosystem requires the constant input of the sun's energy to fuel its food web. A plant (a *producer*) uses this energy to make sugars. It is eaten by an herbivore (a *primary consumer*), which is then eaten by a carnivore (a *secondary consumer*). Sometimes one carnivore is eaten by another carnivore (a *tertiary consumer*). Here's an example of a *winter food chain* that shows the relationships between a producer, a primary consumer, and a secondary consumer:
    - A yellow birch tree (producer) sets buds in the fall in preparation for winter.
    - A snowshoe hare (primary consumer) eats the yellow birch tree buds and twigs.
    - A bobcat (secondary consumer) eats the snowshoe hare.
- All dead organisms and waste materials are broken down by *decomposers.* The nutrients that are released through decomposition are then taken up by plants during the summer growing season and enter the food web again. In this way, matter is recycled within an ecosystem. Please note that decomposition stops in the fall due to cold weather and resumes again in the spring, so decomposition does not occur during the winter.
- Food web interactions transfer *energy* throughout the ecosystem. Only a small amount of energy is retained by the eater at each level. Therefore, an ecosystem needs a whole lot more plants than herbivores, and a whole lot more herbivores than carnivores. Unlike matter, energy is not recycled and must be captured from the sun by plants.
- A food web that has a diverse array of organisms that are connected by many food chains is more stable than a food web with few organisms and few food chains. In nature, high diversity supports a robust ecosystem that is usually able to recover if conditions degrade.

For more information, please see the website, ***Exploring Nature Educational Resources*** (www.exploringnature.org), especially this page: *Food Web Lecture with Handouts* (http://www.exploringnature.org/db/detail.php?dbID=45&detID=2287).

Instructions

1. Introduce students to the food web concept and review the mammals whose Track and sign they investigated along their riparian zone: beaver, bobcat, coyote, ermine, fisher, gray fox, mink, muskrat, otter, raccoon, snowshoe hare, and white-tailed deer.

2. Have each pair of students research one of these mammals to discover what it eats in the winter in Vermont. Your students can find ***Fact Sheets*** on mammals on the ***Vermont Critter Curriculum*** website of the Vermont Fish and Wildlife Department (http://www.vtfishandwildlife.com/vtcritters/wildlife.cfm).

3. Have students add their mammals' food items to their list of riparian food web organisms. (Examples: In the winter, the beaver eats willow bark and twigs, so add willow to the list; the gray fox hunts voles under the snow, so add a vole). Please note that some track and sign carnivores eat track and sign herbivores. (Example: the bobcat hunts and eats the snowshoe hare in the winter).

4. When the students have their riparian food web list of organisms, ask them to draw each organism or cut out a picture of it. The following activity from the ***Exploring Nature Educational Resources*** website shows students how to draw their own animals: http://www.exploringnature.org/db/detail.php?dbID=45&detID=2286.

5. When pictures of all riparian food web organisms are completed, have students arrange them on a large piece of paper or a bulletin board and attach them with glue or tape. Ask them to draw lines from each organism to a winter food that it eats (example: beaver to willow tree). Some organisms, like the bobcat, will have several connecting lines (example: bobcat to snowshoe hare, bobcat to deer, bobcat to muskrat, bobcat to vole). The end result will be a web with many lines drawn in, some of which cross other lines.

6. Ask students to trace the path of energy that travels along an individual food chain in their food web, from the sun to a producer, etc. Remind students that most of the energy available in each "link" of the food chain is lost along the way. Because of this, producers must outnumber primary consumers, which must outnumber secondary consumers. If an ecosystem has tertiary consumers, they are very few in number compared to the producers, which must support the entire food web.

7. Choose an organism and ask students to imagine that it disappeared from the food web (cover it with a piece of paper). What other organisms are affected by this loss? How will this affect the overall food web? Explain that a food web that loses its biodiversity is less stable because the organisms that remain have fewer feeding options.

8. If there is time, have students research the summer foods of their track and sign mammals. Which ones eat the same things? Which ones have different winter and summer foods? Students can make a summer riparian mammal food web using the same approach as the winter food web.

Track and Sign Posters

Students can use their knowledge of track and sign to design a poster that tells a story. Their stories should depict a winter riparian landscape in their area, show available resources for winter survival, and include evidence of mammal activities. Students can write a narrative that explains what each mammal is doing in their landscape (finding prey species, traveling through, finding water, etc.) or do an oral presentation on their posters. This poster activity integrates the questions from the Track and Sign Inquiry Process. (*Where? How? What? Who? When? Why?*)

Students at Braintree School made Track and sign posters after their fieldwork.

Sharing the Learning

After fieldwork, hold an Open House or a Science Celebration that invites other students, parents, and community members to learn about the students' work. When students have opportunities to share their learning, their understanding is deepened and they feel the satisfaction of helping to educate others.

F. GOOD MONITORING PRACTICES

Quality Assurance

Some schools and community groups decide to develop river monitoring programs that generate useful data that can be shared with others. If that is your goal, you will need to build a quality assurance system for your program. According to *The Volunteer Monitor's Guide to Quality Assurance Project Plans* booklet of the U.S. Environmental Protection Agency,

> **Quality assurance** is an integrated management system designed to ensure that a product or service meets defined standards of quality with a stated level of confidence. QA activities involve planning quality control, quality assessment, reporting, and quality improvement. (http://water.epa.gov/type/rsl/monitoring/upload/2002_08_02_monitoring_volunteer_qapp_vol_qapp-2.pdf).

While many schools decide that they don't need a quality assurance project plan (QAPP), some teachers choose to inform themselves and their students about this process because it helps them to understand how valid river monitoring data are generated for decision-making. If you decide to consider writing your own QAPP, please see the document at the website above. (The box below outlines "Steps to Develop a QAPP.")

At a minimum, we recommend that you implement certain QA activities to improve both your students' science education and their fieldwork results. Below we offer General QA Methods for all 4 MWR units, then specific QA Methods for the Riparian Track & Sign unit.

General QA Methods

- The MWR fieldwork techniques are based on scientific protocols developed by river monitoring experts. If you want to share your students' data with other schools across the MWR network, please use the fieldwork sheets included with the units. (If you don't share data, please feel free to adapt the fieldwork sheets.)
- Before fieldwork,
    - be sure you have the equipment and supplies specified by the fieldwork techniques you are using;
    - carefully go over the fieldwork sheets with your students and adult helpers so they understand all parts of the sheet and they know why they are collecting data in a specific way;
    - decide what you will do with student data after collecting it (e.g., will it be summarized in a database? graphed and shared with parents?);
- During fieldwork,
    - encourage students to complete all parts of the fieldwork sheet that they can, and add any information that may clarify or explain their data;

  - document important observations using photographs or collections of items (e.g., a *reference collection* of waterbugs).
  - if possible, invite an expert to accompany you during fieldwork to confirm results.
- After fieldwork,
  - discuss observations and data as a group to fill in missing information and correct mistakes and misunderstandings;
  - label and store fieldwork photographs using an organized system so that you can retrieve them as needed;
  - store fieldwork sheets for future reference. This is especially important if you plan to compare data results from year to year, or share your data with others.
  - if possible, ask an expert to visit your students to check their results and discuss findings and conclusions.

QA Methods for Riparian Track and Sign

- Teach students the four track patterns and how to identify the families of mammals that use each kind of pattern.
- Teach students how to use basic field guides for reference.
- When a group of students moves across their fieldwork site, their many feet often obscure important evidence. Train students to walk carefully, scanning the ground in front of them as they go. If they find evidence, they should notify others in the area to steer clear of it.
- When a student finds some evidence, he/she should determine what it is and then ask someone else to confirm his/her determination. If the two people disagree about what they are seeing, they should document what they see with a photograph or a sketch. If they are not 100% sure what it is, they can make an educated guess on their fieldwork sheet, but note that this is a guess and not a confirmed data point.

Data Management

Once students have collected data, they should review their data to double-check any calculations and to determine important findings. Ask them to review their *Purpose* statement on the fieldwork sheet; did they achieve it? If not, what additional data or other information could they collect to help them better achieve their Purpose?

Work with students to design a sheet (an excel spreadsheet works well) that allows them to summarize their data. Then they can organize their data into tables, charts, graphs, or other formats. Have students compare different formats to see how each one presents their data results in a particular way.

Build a database system for storing datasets from year to year. It's a good idea to have both a digital storage system and a paper-based storage system. Contact the White River Partnership (WRP) for more guidance on managing data. Also check the Resources and Information page of the WRP website (http://whiteriverpartnership.org) to see actual datasets for different water quality parameters.

Steps to Develop a QAPP

(From the Executive Summary of *The Volunteer Monitor's Guide to Quality Assurance Project Plans*, http://water.epa.gov/type/rsl/monitoring/upload/2002_08_02_monitoring_volunteer_qapp_vol_qapp-2.pdf).

Developing a QAPP is a dynamic, interactive process that should ideally involve state and EPA regional QA experts, potential data users, and key members of the volunteer monitoring project. There are 11 steps a volunteer monitoring project coordinator might take to prepare a QAPP. These are:

Step 1: *Establish a small team* whose members will serve as advisors in helping you develop the QAPP by offering feedback and guidance throughout the entire process.

Step 2: *Determine the goals and objectives of your project* – why it's needed, who will use the data, and how the data will be used.

Step 3: *Collect background information* to help you in designing your project.

Step 4: *Refine your projects goals* once you've collected more information.

Step 5: *Design your project's sampling, analytical & data requirements* – essentiall, what, how, when, and where you'll be monitoring.

Step 6: *Develop an implementation plan* that lays out project logistics.

Step 7: *Draft your standard operating procedures (SOPs) & QAPP.*

Step 8: *Solicit feedback on your draft SOPs & QAPP* from state or EPA regional QA contacts and potential data users.

Step 9: *Revise your QAPP* based on review comments and submit it for approval.

Step 10: *Once your QAPP is approved, begin your monitoring program.*

Step 11: *Evaluate and refine your project over time,* and reflect any major changes in a revised QAPP

G. HELPFUL TOOLS

Glossary

assess – to examine something (as a river) in order to evaluate it.

data (singular: datum) – pieces of information that are gathered from experiments, surveys, or other investigations to make calculations or draw conclusions.

ecosystem – a natural system in which all organisms interact with each other and with the physical features of the environment; examples: river, forest, wetland.

ecotone –an ecological zone between two or more ecosystems; an edge habitat.

environmental literacy – the capacity to use an understanding of the natural world to make informed decisions about humans' relationship with it.

ecosystem services – natural services, like nutrient cycling, provided by the natural environment that support life on earth and human economies.

food web – the feeding connections between and among organisms in an ecosystem.

habitat – the place that provides all the essential resources for an organism's survival.

macroinvertebrate – an organism that has no backbone and is large enough to see with the naked eye; examples: insect, worm, snail.

mainstem – the largest river in a river system, into which all water within the river's watershed flows

marsh – a wetland that is characterized by herbaceous (non-woody) plants

meander (as a river) – verb: to twist and curve through the landscape; noun: the winding or bending pattern of a river.

monitor – to check something (as a river) at regular intervals in order to find out whether and how it is changing.

quality assurance – an integrated management system designed to ensure that a product or service meets defined standards of quality with a stated level of confidence.

riparian zone – the area of land along a stream channel where vegetation and land uses directly influence stream processes.

swamp – a wetland that is characterized by shrubs and trees.

taxonomy - the science of classifying organisms into categories based on shared characteristics and natural relationships.

topography – the features on the surface of an area of land.

tributary – a stream that flows into another stream or river.

vernal pool – a temporary pool of water that forms in the spring due to snowmelt and precipitation that supports a specific community of amphibians, insects and other organisms.

watershed – a basin of land in which all water drains down to a common body of water (stream, river, lake, pond, wetland, ocean).

Riparian Track & Sign Resources

Environmental Literacy and Educational Standards

Environmental Literacy for Vermont http://www.environmentalliteracyvt.org/

Environmental Literacy Council http://www.enviroliteracy.org/

Developing a Framework for Assessing Environmental Literacy, North American Association of Environmental Education http://www.naaee.net/framework

Next Generation Science Standards http://www.nextgenscience.org/

Common Core State Standards Initiative http://www.corestandards.org/

General Wildlife Track & Sign Teaching Resources

Animal Tracks Concentration Game (online)
http://www.fws.gov/columbiariver/games/concentration/tracksconcentration.htm#pictures

Wlidlife Tracking in Vermont, Vermont Fish and Wildlife Department
http://www.vtfishandwildlife.com/vtcritters/factsheets/WildlifeTracksVT.pdf

Vermont Critter Curriculum, Vermont Fish and Wildlife Department
http://www.vtfishandwildlife.com/vtcritters/

Riparian Buffers/Zones

Introduction to Riparian Buffers for the Connecticut River Watershed, Connecticut River Joint Commissions
http://www.crjc.org/buffers/Introduction.pdf

Riparian Wildlife Habitat:

Buffers for Habitat, Connecticut River Joint Commissions
http://www.crjc.org/buffers/Buffers%20for%20Habitat.pdf

Fact Sheet #3: Functions of Riparian Areas for Wildlife Habitat
http://www.mass.gov/dfwele/der/riverways/pdf/riparian_factsheet_3.pdf

Chapter 9. Riparian Zones: Managing Early-Successional Habitats Near the Water's Edge
http://www.wildlife.state.nh.us/Wildlife/Northeast_Mgt_Guide/Ch09_Riparian_Zones.pdf

Water Quality

United States Geological Survey (USGS) http://water.usgs.gov/owq/

United States Environmental Protection Agency (USEPA), Water Quality Standards
http://water.epa.gov/scitech/swguidance/standards/

The Volunteer Monitor's Guide to Quality Assurance Project Plans
http://water.epa.gov/type/rsl/monitoring/upload/2002_08_02_monitoring_volunteer_qapp_vol_qapp-2.pdf

River Fieldwork Supplies & Safety Planning

Please review this sheet before taking a group to the river for fieldwork.

Basic River Fieldwork Supplies

The following items are useful for most river fieldwork sessions. You may also need to collect items geared to your specific fieldwork activities.

- boots or waders
- walking stick to maintain balance in the river (can be used to probe for deep spots and to measure depth)
- sunhat and sunscreen lotion
- refreshments and drinking water
- clipboard
- several pencils
- digital camera to document sites, physical conditions, and/or organisms collected
- plastic gloves (if there is a concern about pollution; see Safety Guidelines below)

Safety Guidelines

1. Develop a ***Safety Plan*** for your river fieldwork sessions (see suggested outline below). Make sure that all adults know what to do in an emergency at the river, and bring your Safety Plan with you during every fieldwork session for important information that will help you deal with the emergency.
2. Never do fieldwork in **severe weather**, and *get out of the water during a lightning storm.*
3. If there is a **dam** upstream of your river site, be aware of the dates and times when water is released from the dam since this results in sudden flooding downstream of the dam.
4. Bring **snacks and drinks** if your group will be outside for a while. If the weather is cold, bring warm drinks to guard against hypothermia.
5. Carry a **whistle** with you during fieldwork to communicate with members of your group and to signal for help if needed.
6. Always wear **footgear** in the river – never wade in barefoot because glass and other sharp objects could pose hazards. Footgear with covered toes (such as old sneakers) are ideal.
7. Remember that getting wet increases the chances of hypothermia. During cool or cold weather, have everyone bring **extra dry clothes and footgear** and keep them dry.
8. Confirm that you are at the **correct river site** by checking maps, site descriptions, and/or directions.
9. Always conduct fieldwork with at least one **partner**. Teams of three or four people are best. Always **let someone else know** where you are and when you intend to return.
10. Find a **safe path** down to the river's edge. If the path is too steep, too slippery, lined with poison ivy, or too heavily forested to keep everyone safe, choose another way to get to your fieldwork site or choose another site.
11. Do not walk on **unstable riverbanks**. This can cause erosion and might be dangerous if a bank collapses. Disturb riverside plants as little as possible.
12. Do not touch river water, or wear plastic gloves, if you know or suspect that it is **polluted**. Both organic pollution (caused by human or livestock wastes) and toxic pollution (caused by certain mines, industries, and pesticides) can create unacceptable human health risks.
13. ***High and/or fast river water*** *can be very dangerous. Please enter the river only if the water level is below the knee and you can move around in the current without struggling.*
14. Be very careful when **walking in the river**. The riverbed can be very slippery and can contain deep pools. If you must cross the river, use a walking stick to steady yourself and to probe for deep water, soft mud, or unseen rocks. Your partner(s) should wait on dry land to assist you if you fall.
15. After fieldwork, and before eating anything, **wash your hands** thoroughly with soap to remove any pathogens or other pollutants that may be present in the river water.

RIVER FIELDWORK SAFETY PLAN
(Suggested Outline)

Name of person supervising your Safety Plan:

Contact information for this person:

Medical facility that is closest to your river fieldwork site(s):

Will person who accompanies the fieldwork group to the river have a cell phone with him/her?

- ❒ Yes
- ❒ No; if not, how will he/she summon help if needed?

Telephone number of closest medical facility:

Directions to medical facility:

Please collect information from all members of your group regarding medical issues that may require attention at the river (e.g., bee sting allergy), and obtain permission to treat members if necessary.

Please check one box below.

- ❒ Medical release forms completed and signed for each member *(essential for children)*.
- ❒ Medical release forms not necessary.

Please check one box below and complete as necessary.

- ❒ There are no medical issues in our group.
- ❒ We have identified the following medical issues and remedies (e.g., bring bee sting kit):

Medical issue: _____

Remedy: _____

Medical issue: _____

Remedy: _____

Medical issue: _____

Remedy: _____

Medical issue: _____

Remedy: _____

Other important notes regarding safety during river fieldwork:

Safety Plan prepared by: Date: