Water Habitat Site Study

Meet the water dwellers in your local pond, stream, or lake.
What are the special features that help them survive in the water?

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Please note: Academic Standards are updated regularly and our alignments will be updated on the DNR Academic Standards Website at: www.mndnr.gov/education/teachers/edstandards_intro.html

Water Habitat Site Study

Minnesota Academic Standards

◒ Lesson *introduces* this Benchmark.
◒ Lesson *partially* addresses this Benchmark.
● Lesson *fully* addresses this Benchmark.

Language Arts

Grade 3
I. Reading and Literature
A. Word Recognition, Analysis, and Fluency:
Benchmark 1—The student will read unfamiliar complex and multi-syllabic words using advanced phonetic and structural analysis. ◒
B. Vocabulary Expansion:
Benchmark 1—The student will acquire, understand and use new vocabulary through explicit instruction and independent reading. ◒
C. Comprehension:
Benchmark 1—The student will read aloud grade-appropriate text (that has not been previewed) with accuracy and comprehension. ◒
Benchmark 2—The student will recall and use prior learning and preview text, using title, headings and illustrations to prepare for reading. ◒
Benchmark 7—The student will follow three-step written directions. ◒
II. Writing
D. Research:
Benchmark 1—The student will use grade-level appropriate reference materials to obtain information from dictionaries, glossaries, encyclopedias, and the Internet. ●
III. Speaking, Listening, and Viewing
B. Media Literacy:
Benchmark 1—The student will participate in and follow agreed-upon rules for conversation and formal discussions in large and small groups. ●
Benchmark 2—The student will demonstrate active listening and comprehension. ●

Grade 4
I. Reading and Literature
A. Word Recognition, Analysis and Fluency:
Benchmark 1—The student will read unfamiliar complex and multi-syllabic words using advanced phonetic and structural analysis in grade-appropriate text. ◒
B. Vocabulary Expansion:
Benchmark 1—The student will acquire, understand and use new vocabulary through explicit instruction and independent reading. ◒
C. Comprehension:
Benchmark 1—The student will read aloud grade-appropriate text (that has not been previewed) with accuracy and comprehension. ◒
Benchmark 2—The student will recall and use prior learning and preview text to prepare for reading. ◒
Benchmark 9—The student will follow multiple-step written instructions. ◒
II.Writing
B. Elements of Composition:
Benchmark 4—The student will create informative reports, including gathering material, formulating ideas based on gathered material, organizing information, and editing for logical progression. ●
D. Research:
Benchmark 1—The student will locate information in various reference materials including dictionaries, online dictionaries, glossaries, encyclopedias, and the Internet. ●
III. Speaking, Listening, and Viewing
B. Media Literacy:
Benchmark 1—The student will read print, view pictures and video images and listen to audio files and identify distinctions in how information is presented in print and non-print materials. ●
Benchmark 3—The student will use print, pictures, audio and video to express ideas and knowledge gleaned from these sources. ●

Grade 5
I. Reading and Literature
A. Word Recognition, Analysis, and Fluency:
Benchmark 1—The student will read familiar, complex and multi—syllabic words using advanced phonetic and structural analysis.
B. Vocabulary Expansion:
Benchmark 1—The student will acquire, understand and use new vocabulary through explicit instruction as well as independent reading.
Benchmark 4—The student will analyze word structure and use context clues in order to understand new words.
C. Comprehension:
Benchmark 1—The student will read aloud grade—appropriate text (that has not been previewed) with accuracy and comprehension.
Benchmark 13—The student will follow multiple—step written directions.
D. Literature:
Benchmark 1—The student will read a variety of high quality, traditional, classical and contemporary literary works specific to America, as well as significant works from other countries.

Science

Grade 3
I. History and Nature of Science
A. Scientific World View:
Benchmark 1—The student will explore the use of science as a tool that can help investigate and answer questions about the environment.
B. Scientific Inquiry:
Benchmark 2—The student will participate in a scientific investigation using appropriate tools.

Grade 4
IV. Life Science
B. Diversity of Organisms:
Benchmark 1—The student will classify plants and animals according to their physical characteristics.
Benchmark 2—The student will learn that the characteristics used for grouping depend on the purpose of the grouping.

Grade 5
I. History and Nature of Science
B. Scientific Inquiry:
Benchmark 1— The student will perform a controlled experiment using a specific step-by-step procedure and present conclusions supported by the evidence.
C. Scientific Enterprise:
Benchmark 1—The student will describe different kinds of work done in science and technology.

Environmental Literacy Scope and Sequence

Benchmarks

- Social and natural systems are made of parts. (PreK-2)
- Social and natural systems may not continue to function if some of their parts are missing. (PreK-2)
- When the parts of social and natural systems are put together, they can do things they couldn't do by themselves. (PreK-2)
- In social and natural systems that consist of many parts, the parts usually influence one another. (3-5)
- Social and natural systems may not function as well if parts are missing, damaged, mismatched or misconnected. (3-5)

For the full Environmental Literacy Scope and Sequence, see:
www.seek.state.mn.us/eemn_c.cfm

Chapter 1 • Lesson 4

Water Habitat Site Study

Grade Level: 3-5
Preparation Time: 15 minutes
Activity Duration: Part 1: 60 minutes for field trip
Part 2: 30 minutes for food web activity
Group Size: 1-30
Subject Areas: Expressive Arts, Language Arts, Science
Academic Skills: classification, comparison, drawing, observation
Setting: outdoors, at a body of water
(Lesson can be done indoors if specimens are collected within three hours prior to class starting time start of class. Fall and spring collections yield primarily macroinvertebrates. Summer and early fall collections yield primarily plants.)
Vocabulary: aquatic, aquatic ecosystem, benthic organisms, emergent plants, floating-leaf plants, free-floating plants, habitat, identification key, littoral zone, macroinvertebrate, metamorphosis, pollution, runoff, submerged plants, vertebrate
Internet Search Words: aquatic macroinvertebrates, aquatic plants, pond life

Instructor's Background Information

Aquatic refers to water. Scoop some water from a stream or pond, look closely, and you'll find some fascinating living organisms. These small aquatic plants and animals are crucial components of an aquatic ecosystem. They're extremely important for healthy aquatic food chains and food webs. (See **Lesson 1:2—Food Chain Tag** for more information on aquatic food chains.) An **aquatic ecosystem** is any body of water (such as a stream, river, or lake) and all of its organisms and nonliving components that, together, function as a natural system. A **habitat** is an area that provides food, water, cover, and space to adequately meet an organism's survival needs. The ability to identify each organism in an aquatic ecosystem is, for young children, less crucial than having the opportunity to discover the diversity of life in a pond or stream—and spending some time contemplating how fish rely on these many aquatic organisms for survival.

Aquatic Plants

Minnesota streams, rivers, ponds, lakes, and wetlands are home to approximately 150 species of aquatic plants and macroscopic (visible to the unaided eye) algae categorized into four groups. Aquatic plants that are not attached to the bottom and float on the surface are **free-floating plants**. Examples include duckweed, planktonic algae, and watershield. Plants that are attached to the bottom, and have true

Summary

In this activity, students explore a local water ecosystem and discover organisms living in various habitats. Many of these organisms provide food and cover for fish. Each student collects aquatic invertebrates using a dip net and sorts through muck scooped from the lake bottom. Students also use a rake to collect aquatic plant specimens. They'll have the opportunity to sketch the specimens, and to use field guides and identification keys to study and identify the plants and animals. From these sketches, they'll make a pond, stream, or lake discovery book.

Student Objectives

The students will:

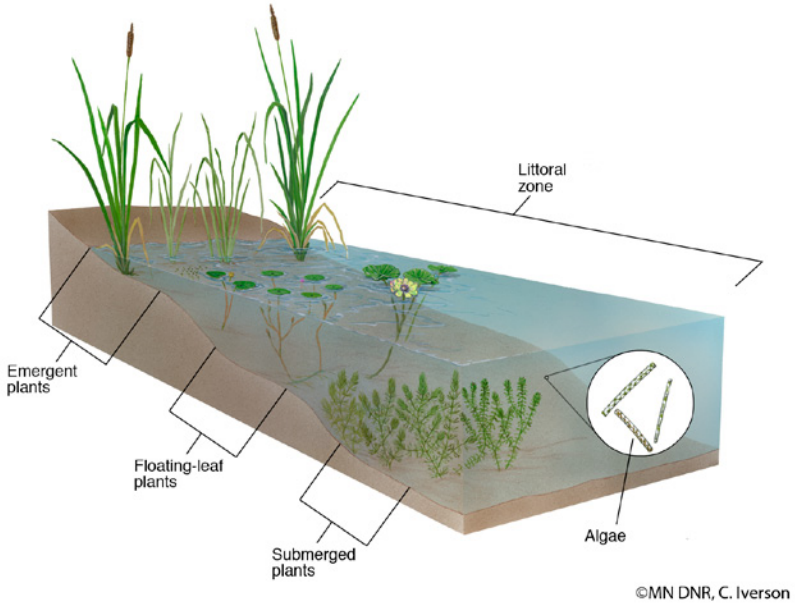
1. Collect specimens of aquatic plants, macroinvertebrates, and other animals from a variety of habitat types in a local water ecosystem using a dip net, rake, and bottom-sifting sampling methods.
2. Observe features or adaptations of aquatic organisms.
3. Draw and describe examples of organisms collected with each sampling method.
4. Use field guides or identification keys to identify aquatic plants and animals.
5. Group illustrations of organisms into types or categories and create and illustrate a pond, stream, or lake discovery book.

Materials

- **Aquatic Insect Life Cycle Sheet**, one per student (or as projection)
- **Water Habitat Site Study Identification Key** to plants and animals
- **Water Habitat Site Study Check-Off Sheet**, one per group or per student
- Various pond life field guides (See Part 1, Step 2 of lesson for recommendations.)
- Kitchen strainers, dip nets, or Hester-Dendy collectors
- Rake
- Shovel
- Buckets, two
- White trays with sides (such as plastic ice cube trays, which separate organisms for study), three or more
- Assorted containers or plastic cups
- Spoons
- Tweezers or forceps
- Magnifying lenses (worn on straps)
- Clipboards, preferably plastic covered, or five by seven-inch spiral-bound sketchbooks
- Pencils
- Paper, for drawing pictures of organisms
- Camera and film, to document field conditions
- Video program about pond life (optional)
- Drawing paper and materials for creating a class pond, stream, or lake discovery book

continued

stems, roots, and leaves with more than half of their vegetative parts projecting from the water are **emergent plants**. Examples include wild rice, cattails, and bulrush. Rooted plants with leaves that float on the surface are called **floating-leaf plants**. Examples include water lilies and lotus. Plants that grow completely underwater or with more than half of their parts growing beneath the surface are **submerged plants**. Submerged plants include wild celery, coontail, and water milfoil. Non rooted plants that float on the surface and can drift, such as duckweed, are called **free-floating plants.**



The zone in which emergent, floating-leaf, and submerged plants grow is known as the littoral zone. In many Minnesota lakes, the littoral zone extends to a depth of approximately fifteen feet.

Aquatic plants are important to fish and to other organisms in the ecosystem. Plants make their own food through photosynthesis, a process that uses the energy from the sun. Oxygen, a by-product of photosynthesis, is dissolved in water and respired by fish and other aquatic animals. Plants also provide food, cover, and spawning habitat for many types of fish and other animals. Many submerged plants provide food for waterfowl, as well as habitat for the insects they eat.

Aquatic plants further benefit water bodies and aquatic animals by absorbing excess nutrients, such as phosphorus and nitrogen, from runoff. **Runoff** is the water that "runs off" the land into lakes, streams, wetlands, and rivers.

Emergent plants also protect shorelines and bottoms by dampening wave action, stabilizing sediments, and preventing erosion.

Sheltering vegetation in or along the water provides food and cover for macroinvertebrates, fish, turtles, frogs, muskrats, snakes, birds, and many other types of wildlife. The loss of this vegetation can result in the loss of animals, too.

Aquatic Macroinvertebrates

Aquatic macroinvertebrates are animals without backbones (invertebrates) that are large enough to be seen with the unaided eye (macro) and spend most or all of their life cycles in water (aquatic). Examples include mosquitoes, mayfly larvae, pouch snails, blackfly larvae, crayfish, whirlygig beetles, water striders, dragonfly larvae, and fingernail clams.

Aquatic macroinvertebrates are found swimming freely, or attached to things like rocks, docks, plants, or fallen logs, or buried in the bottom sediments of lakes or streams. A good way to find macroinvertebrates is to pick up a rock or log in a stream or along the lakeshore and watch the rock or log's surface for movement.

Macroinvertebrates can be herbivores, carnivores, or omnivores. Herbivorous invertebrates consume plants and algae. The macroinvertebrates that eat small fish, small amphibians, and other invertebrates are carnivores. Omnivores eat both plant and animal material. Aquatic macroinvertebrates are consumers, and they also provide food for other organisms such as fish, birds, frogs, and turtles. They're critical to a healthy aquatic ecosystem.

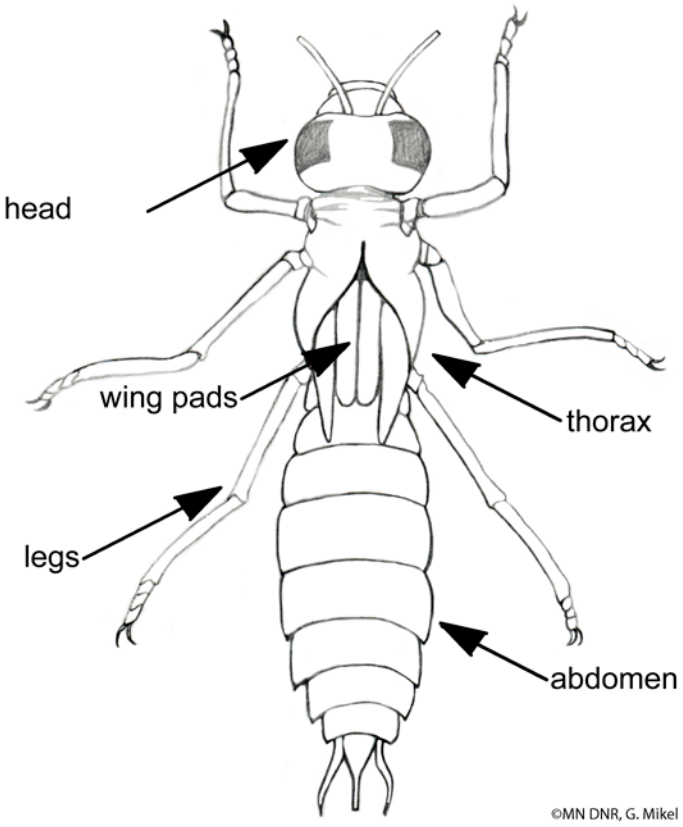
Organisms at various stages of their species' life cycle can be collected in a single water sample. At each life stage, members of the same species can look quite different from one another and display different characteristics. This is clearly illustrated by aquatic insects. You can collect dragonfly larvae from the water while the adults of the same species fly in the air around you.

Aquatic insects are a group of macroinvertebrates that have three-part bodies (with a head, thorax, and abdomen), and, in the adult stage, six legs. Aquatic insects live all or parts of their life cycles in the water.

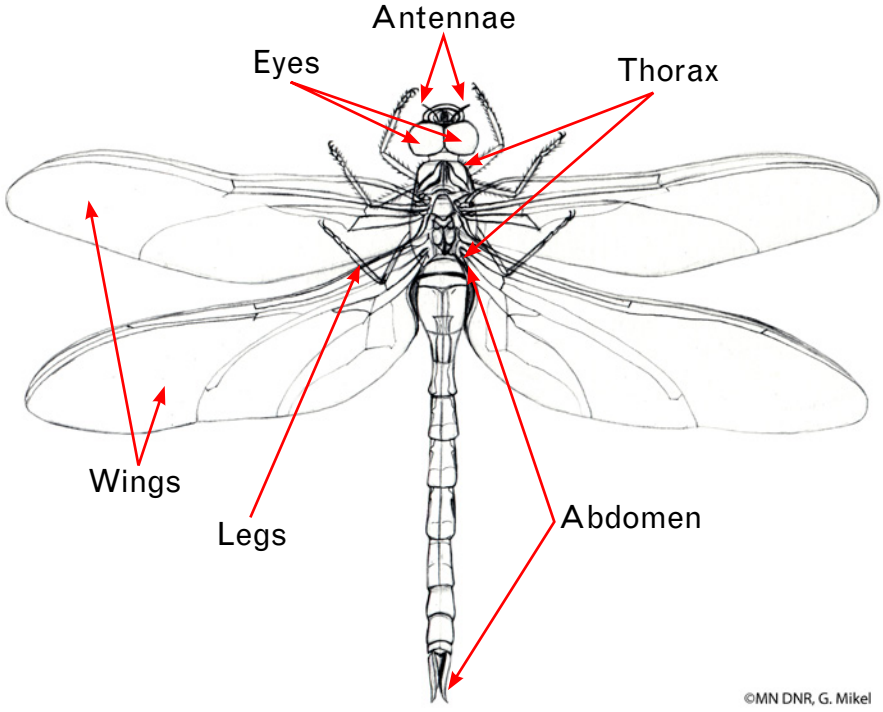
Materials (continued)

Basic Safety Equipment for Field Activities

- Waterproof shoes, rubber boots, or waders
- Walking stick (with measurements) for balance, probing, and measuring
- Insect repellent and sunscreen
- First aid kit
- Tarps, for gathering areas, sitting, and setting trays
- Towels, in case someone gets wet
- Whistle to summon help in emergencies, and to signal the beginning and end of activities
- Refreshments and drinking water



Dragonfly larva



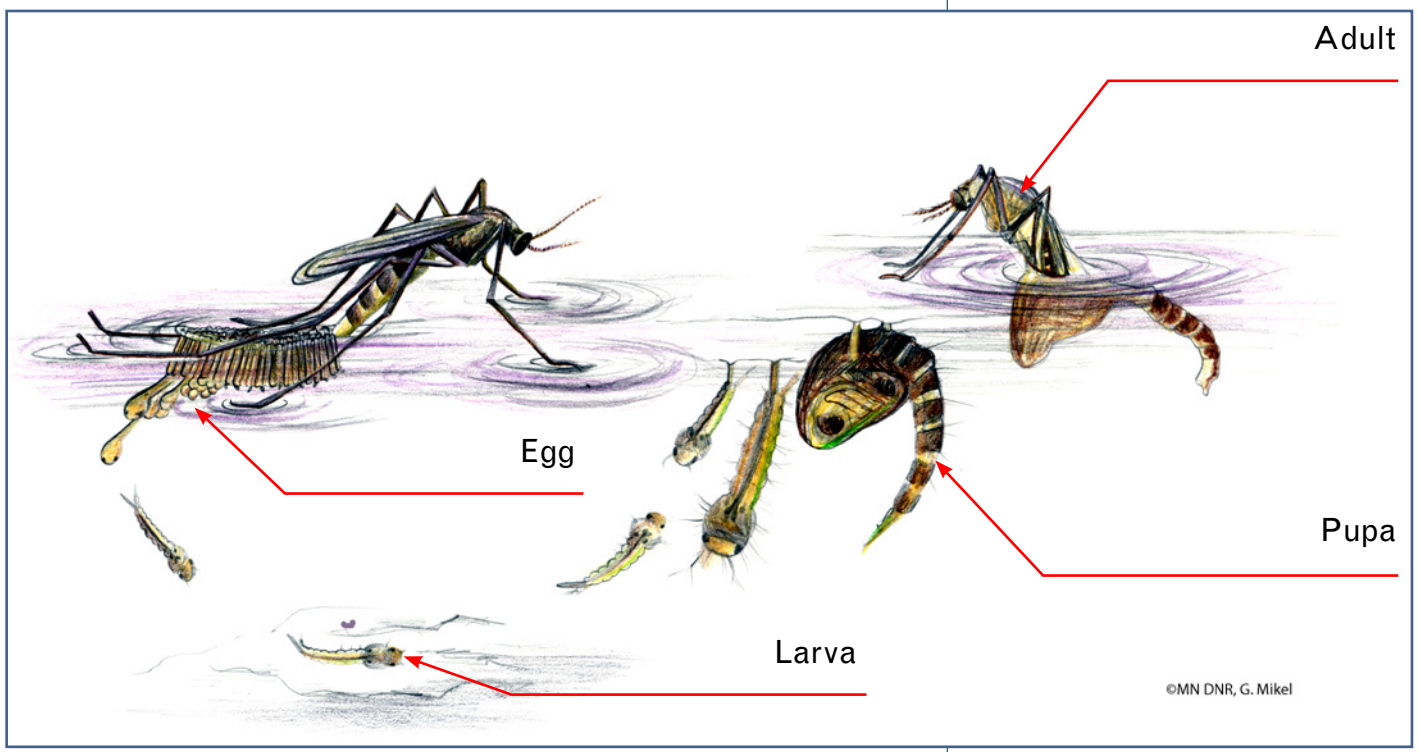
Adult dragonfly

A dragonfly larva spends most of its life cycle in the water before emerging to the air as an adult.

Macroinvertebrates, such as whirligig beetles, snails, aquatic sowbugs, and leeches, emerge from eggs, grow, and become adults without leaving the water. Most aquatic insects, however, spend at least a few days of their lives as winged adults in the air. Dragonflies, after as long as two years of development in the water, emerge to the air as adults to feed and to mate. Mayfly larvae and adults also have different features. The larvae have mouths, but the adults don't. Adults are too short-lived and occupied with mating to even need mouths—they die within seven days of emergence and mating. Although they're referred to as mayflies, various species from this group emerge all year long—some even in the dead of winter.

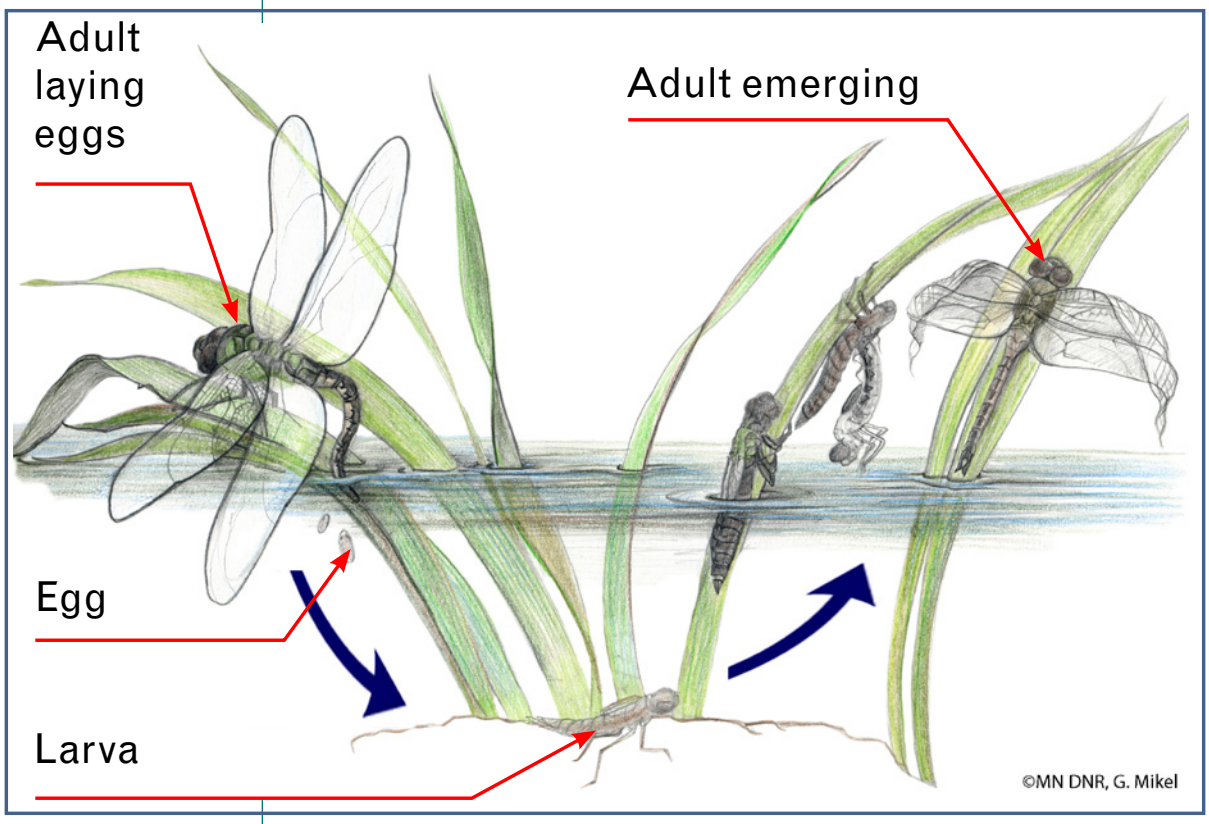
Many aquatic insects undergo numerous dramatic physical changes during their life cycles. The series of stages that the young undergo on the way to maturity is known as **metamorphosis**. There are two basic types of metamorphosis.

Complete metamorphosis involves a series of four stages. An egg matures, becoming a larva, a pupa, and finally, an adult. The pupa is non-feeding, typically in a cocoon or hardened case. The appearance of insects that undergo complete metamorphosis changes dramatically as they pass from one stage to the next. Examples of insects that undergo complete metamorphosis include mosquitoes, caddisflies, and blackflies.



During the process of complete metamorphosis, the mosquito matures from egg to larva to pupa to adult.

Incomplete metamorphosis, a more primitive type of development, doesn't include a pupa stage. After hatching from its egg, the young insect undergoes a series of instar stages (or molts), shedding its exoskeletons and growing ever larger until it emerges directly from its exoskeleton as a winged adult. Examples of insects that undergo incomplete metamorphosis include dragonflies, stoneflies, and damselflies.



During incomplete metamorphosis, the dragonfly matures from egg to larva to adult.

Aquatic Vertebrates

Vertebrates are animals with backbones or spines. Aquatic vertebrates include fish, turtles, salamanders and frogs. Vertebrate organisms (such as minnows or other small fish or tadpoles) might also be collected in your samples.

Aquatic Plants and Macroinvertebrates Are Indicators of Water Quality

Biologists often monitor aquatic plant and macroinvertebrate populations to determine habitat diversity and to measure water quality. The proportion of rooted aquatic plants versus algae is a good indicator of water quality. The absence of rooted aquatic plants and a high concentration of algae indicates excessive nutrient input from the surrounding watershed.

Macroinvertebrates are excellent indicators of water quality because they usually live most or all of their life cycles in the same area of a

stream or lake, so changes in their populations can be directly related to changes in their water habitats.

Pollution is any substance or condition that makes water less useful or desirable. Pollution impairs water quality. Some species of macroinvertebrates are more tolerant of pollution and low water oxygen levels than others. For example, leeches, pouch snails, and aquatic sowbugs are relatively tolerant of pollutants. Stonefly larvae, alderfly larvae, and Dobsonfly larvae (sometimes referred to as hellgramites) are very sensitive to pollutants in the water. Crayfish, dragonfly larva, and clams are aquatic macroinvertebrates usually found in water of moderate (or better) quality. Identifying the macroinvertebrates that appear in a sample can give clues to the water quality of the lake or stream. For example, if most of the macroinvertebrates sampled are pollution-tolerant species, the lake or stream may be polluted. Or, if many of the macroinvertebrates sampled are pollution-sensitive species, the lake or stream may be healthy.

If aquatic macroinvertebrate monitoring indicates a possible water quality problem, definitive chemical analyses are needed to determine which pollutants or other water quality issues are impacting the health of the organisms. See **Lesson 3:6—Macroinvertebrate Mayhem** for more information on macroinvertebrates as water quality indicators.

Identification and Observation of Diversity Build Understanding

Identification keys, field guides, and careful observations can unlock the identity of the plants and animals that the students collect. The varied features of the specimens also highlight the diversity exhibited in aquatic habitats. The more students observe aquatic plants and animals and their interactions, the better they'll understand the importance of these organisms and their roles in aquatic ecosystems.

Sampling Techniques
Collecting plants and animals from a stream is a fun and exciting activity for students. They'll be surprised and amazed by the whole new water world they discover. Plants can be collected using common kitchen strainers and a rake.

Macroinvertebrates and other animals are collected in various ways. One common technique is to place a collection net in a stream and then use a stick, hands, or feet to stir the gravel *upstream* from the net. Dislodged animals will be then wash into the net. Empty the contents of the net into a specimen bucket for observation and identification.

Kick Nets
Kick nets are used in streambeds and are useful for rapid coverage of bottom dwelling organisms from large sections of water. One type of kick net has two rods or handles with a mesh net between them. The

Macroinvertebrates tolerant of polluted water or low oxygen will also thrive in clean, well-oxygenated water. Finding only pollution-tolerant species in a lake or stream indicates that the water is polluted or low in oxygen.

When collecting aquatic plants and animals, take care to minimize impact at the site. Collect small amounts of plant and animal material—it isn't necessary to take large samples.

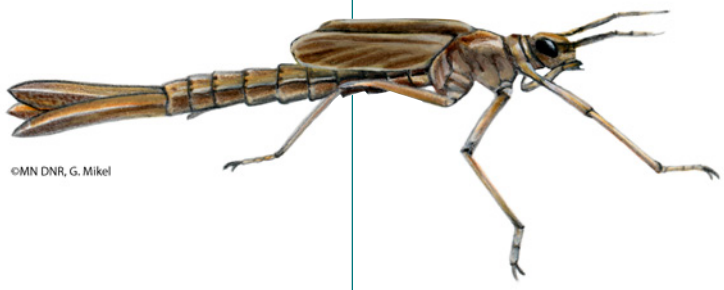
It is illegal to remove aquatic vegetation from areas posted by the Minnesota DNR as Infested Waters, Scientific and Natural Areas, or Fish Spawning Areas.

net is stretched across fast-moving water and placed on the bottom to trap organisms. One person holds the net and another kicks the rocks in front of the net, dislodging animals on the rocks. The animals flow downstream and the net captures them. The net can be folded for carrying. The bottom of the net is weighted to keep it from floating during sampling.

A mesh kick net with two handles.

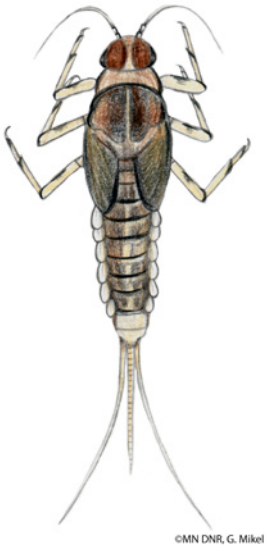
Make your own kick net by stapling a section of screen to two four-foot long dowels.

Dip Nets
These nets are designed for sweeping over light vegetation or for use in shallow ponds and streams.



D-frame Dip Net
A D-frame dip net ring is made of steel and is D-shaped with a flat bottom. It's wrapped in heavy, durable muslin, with rope reinforcement at the net ring. The bottom of the net has mesh screening that allows water to flow through, catching organisms, plants, sediment, and other debris. The ring is attached to a long wooden handle that's usually about five feet long.

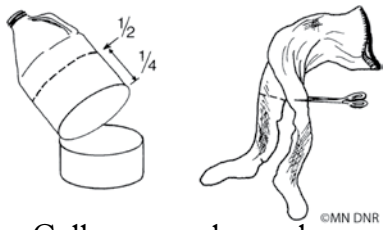
A D-frame dip net.



Triangle Dip Net
A triangle aquatic dip net is designed to take samples in heavy weeds. The steel ring is triangle-shaped, with heavy muslin and rope reinforcement at the net ring. Like the D-frame dip net, the bottom side is flat, but the top side comes to a narrow point with an attached handle.

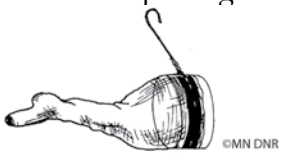
A triangle dip net.

How to Make a Simple Dip Net



1. Collect enough coat hangers, pantyhose, and plastic bottles for each net that you plan to make. Prepare bottles and pantyhose as illustrated. The bottoms of the bottles can be saved and used as study trays for the collected specimens.

2. Insert the middle section of the plastic bottle into the top of the panty hose and attach it with waterproof glue.

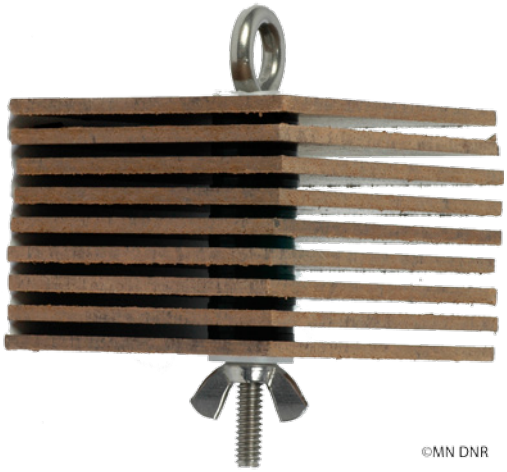


3. Make a handle by bending the wire coat hanger to fit around the bottle. Secure the hanger to the bottle by with a few wraps of duct tape.

4. The top portion of the bottle can be used to scoop or dredge bottom sediments to look for benthic (bottom dwelling) invertebrates. Attach a piece of mesh screening to the screw-top opening of the bottle top by twisting a wire (or wrapping a rubber band) tightly around the screening and cap threads. Scoop a thin layer of bottom sediments, allow the water to filter through the screening, and look for invertebrates wiggling in the remaining sediments.

Hester-Dendy Sampler

A Hester-Dendy sampler is a commonly recommended device for aquatic macroinvertebrate sampling. It's compact, lightweight and inexpensive. It can be suspended, floated, or attached to underwater objects (such as large rocks, or a post) and left in the water for as long as two weeks. When it's retrieved from the water, the aquatic macroinvertebrates can be collected from the plates, put in trays, observed, and identified.



A Hester-Dendy sampler.

Benthic Dredges

Aquatic macroinvertebrates can also be found inhabiting the muck and sediment in the bottoms of lakes and streams. Organisms that inhabit the bottom substrates of water bodies are **benthic organisms.** Benthic bottom dredges, also known as "grabs," are devices usually used to sample macroinvertebrates from the top few centimeters of sediments on lake, reservoir, or pond bottoms. They're essentially metal scoops attached to a rope or cable. The scoops resemble miniature construction shovels. Four sizes of dredges—the Peterson dredge, the Ponar Dredge, the LaMotte Dredge, and the Eckman Dredge—are used to collect samples from different types of terrain. The small and lightweight Eckman Dredge is typically used to collect samples from finer silt and sand bottoms. A dredge is usually lowered to the bottom of a body of water from a boat with a winch or by hand. The end of the rope or cable is secured to reduce the risk of losing the dredge. The dredge is "tripped" to grab and hold a sample of sediment, and retrieved from the water. A bucket is placed under the dredge just before the dredge is lifted above the surface, so that none of the sample drips away.

An Eckman dredge.

Making Your Own Dredges
You can make a dredge or "muck scooper" for collecting benthic organisms. Use an empty soup can for the scoop, and attach it to a handle with three screws, nuts, and washers. For the handle, use a long, sturdy dowel (or a one-by-two board) at least three feet long.

A homemade dredge, also known as the muck scooper.

Macroinvertebrates can also be obtained by collecting a few submerged rocks from a lake, pond, or stream. Place them in a bucket, take them back to the classroom, then very gently scrub the bottoms of the rocks with a soft dishwashing brush to dislodge the macroinvertebrates into the water.

Procedure

Preparation

1. Before the class trip, visit the site. Survey the entire area you plan to study. Look for possible safety concerns such as steep banks, fast-moving water, loose footing, thick brush, and poison ivy. Become familiar with the plants and animals that live in and near the body of water.
2. Choose collection sites. Your areas for collecting specimens should be shallow, accessible, and safe. Beach areas provide little habitat for aquatic plants and animals. Docks, fishing piers, and areas with vegetation, rocks, and fallen logs will provide a wider diversity of species.
3. Obtain permission to use the site if it is located on private land.
4. Discuss with your students what they should wear for the field trip to the pond.

Protect Minnesota's Aquatic Resources and Native Species

For additional information, see *A Field Guide to Aquatic Exotic Plants and Animals*, a brochure available from the Minnesota DNR.

- The law prohibits removing aquatic vegetation within areas posted by the Minnesota DNR as Infested Waters, Scientific and Natural Areas, or Fish Spawning Areas. Obtain all required permits, refer to the current Minnesota fishing regulations booklet, or check with MinnAqua staff, your local conservation officer, or a DNR resource biologist for proper procedures concerning transportation, collection, and disposal of water and aquatic organisms. You can refer to *Minnesota Rules Chapter 6280 Item G, and the Minnesota Exotic Species statutes Chapter 84D*. These rules and guidelines will also help prevent the spread of invasive species and diseases to native aquatic organisms.
- Never put water, plants, animals, or sediment from one aquatic system into another.
- All sample-collecting equipment should be dried or frozen after use to prevent the spread of aquatic diseases and invasive species. Or, if it is to be used again in an infested area, mark that equipment and only use it in the same infested waters. Your Minnesota fishing regulations booklet may not include the most recently infested waters. For more information on aquatic invasive species and infested waters see:
  www.mndnr.gov/eco/invasives.html

If you can't take the students to a body of water, you can go out beforehand and collect a sample large enough to evenly divide between groups in the classroom. Students can then pick through the water and debris to locate, observe, draw, and identify organisms.

- This activity will disrupt the pond bottom or streambed, which can stir up any contaminants that may have settled in the water body. Avoid areas of major contaminant spills, as well as areas near discharge sites.
- Do *not* repeatedly use a single area for habitat site study visits. Give each area time to recover by rotating to another spot—this way, you'll limit harm to a good study area.

Activity

Warm-up

1. Prior to going outdoors, ask the students which living things they expect to find in different places or different habitats of the pond or stream. After making a list, ask the students why it might be important to identify these organisms.
2. Explain how to use an identification key. Define ecosystem.
3. Explain that different organisms can be found in different types of aquatic habitats.
4. You may wish to show a video program on pond life to the class. There are many excellent video programs on freshwater life available (such as *Eyewitness Nature Pond and River* and *Animal Discovery Fun for Kids! Pond Life*, available through SVE & Churchill Video).
5. Discuss the life cycles of aquatic insects and explain that students may find macroinvertebrates in different life stages. Hand out copies of the **Aquatic Insect Life Cycle Sheet** or project it in the classroom.

6. Review the basic safety rules (or guide the class in creating their own list of safety rules).
   - Ask students to stay dry and remain within set boundaries.
   - Discuss the importance of minimizing impact on the sample area by treading lightly, taking only small amounts of samples, and placing rocks, water organisms, and other materials back in their original positions at the conclusion of the activity.
7. Tell the students how to use the equipment at each station. They'll use different kinds of equipment to collect organisms from different habitats in the lake or pond.
   - At Station 1, use strainers and dip nets for scooping into the water from shore or a dock. Place strained items into a bucket of water on shore. Students on shore can sift through the bucket and place organisms on shallow white trays (with water) for easy viewing.
   - At Station 2, from shore, use a shovel or homemade dredge to collect loose material and substrate from the bottom and put it in a bucket. The students can sift through the material with spoons, tweezers, or small cups. Use the shovel with care. Small scoops will yield many organisms that live in the bottom muck.

Do not transport water, plants or animals from areas known to be infested with harmful invasive plants or animals. Look for signs or postings indicating the presence of invasive species. Be careful not to fragment plants or leave organisms along the shore. Check the Minnesota DNR website for a current list of infested waters.

To save time, you may have each group bring their sample trays, after one rotation, to a central location where all students can identify and draw the organisms. At the completion of the activity, carefully return all specimens to the water body.

You may wish to divide the students into six groups so the groups are smaller and more manageable. In that case, you'll need to set up two of each of the stations at the site.

- At Station 3, use the rake from shore to collect small amounts of submerged aquatic plants from the water into a bucket. Students can separate different types into shallow trays. Do not disturb or remove emergent plants that can be easily observed from shore (such as cattails, water lilies, and bulrushes). Instead, point them out to students to identify using identification keys or field guides.
- At each station, use half of the time for collecting specimens and placing them into white trays for observation. Use the second half of your time to examine the organisms closely. Use magnifying lenses. Notice the special features of the different plants and animals. Use identification keys to identify the organisms. Make a detailed drawing of each different type of specimen in your tray.
- At the instructor's signal, carefully empty trays and return specimens to the water. Leave sampling equipment at the station for the next group. Rotate to the next station.

8 Divide the students into three working groups. Assign one or two adult supervisors to each group. If you have two adult volunteers per group, one volunteer can help students with the collection equipment while the other helps students identify organisms.

9 Determine locations for the three stations and set the necessary equipment at each station.

Lesson

Part 1: Sampling and Identification

1 Begin with a site survey. Pause with your students—away from the water's edge—and take in the site. Be observant! Look, listen, and note the sights and sounds. Note the weather conditions, amount of vegetation, and the most prominent signs of living things in the area. What evidence of human activity do you observe?

2 Distribute sampling equipment to each student group: buckets, white trays, strainers, dip nets, and small rakes or shovels. Each student should have a clipboard or other firm writing surface, paper or a journal, a pencil, and a **Water Habitat Site Study Check-Off Sheet**. Each instructor and adult leader should have copies of the identification keys:

- **Water Habitat Site Study Identification Sheets** and **Keys** in this lesson
- *A Guide to Aquatic Plants*, Minnesota DNR
- *Through the Looking Glass: A Guide to Aquatic Plants*, University of Wisconsin-Extension

3 Signal the groups to rotate to each of the three stations. Each group should have time to collect, draw, and identify several plants or animals at each station. Students should also check off the organisms that they find on the **Water Habitat Site Study Check-Off Sheet.**

4 Carefully return the animals and plants to the exact locations from which they were collected.

Station 1

- Use the dip nets to collect organisms on or below the water's surface. This should be done from a gentle sloping bank or from a fishing pier. Set your net firmly against the bottom of the pond or stream, and sweep to dislodge animals that live on or under rocks, allowing them to float into the net.
- Students should place their specimens in the white trays. The white of the trays allows details to be seen in the organisms collected. Keep about an inch of water in the tray and place it in a cool, shady spot. Change the water as often as needed to keep the animals cool.
- Have each student study and draw one or two different animal or insect specimens. Use the key to help identify the animals and label the drawings.

Station 2

- Sift through the mud and muck from the bottom that an adult leader has collected using a small shovel or homemade dredge. A small scoop of substrate is adequate, just enough to place on a tray. (The students may use their bare hands, spoons, tweezers, and cups for sifting.) This group could also try stirring up the bottom muck and silt, then scooping up organisms with a net or strainer.
- Place about one inch of water in a tray and empty the contents of the shovel onto it. Sift through the debris to look for small animals that might be hiding. Consider why these tiny animals are more abundant than larger creatures like fish and crayfish in your sample.
- Have each student study and draw three different animals on separate sheets of paper. Use the key to help identify the animals and label the drawings.

Station 3

- Sort through the plant samples collected with the rake and a strainer. Remember to make the least possible impact and take only what is needed. Place small pieces of the collected plants in the white tray.
- Have each student study and draw three different plants on separate sheets of paper. Use the key to help identify the plants and label the drawings.

Part 2: Use the Drawings to Create a Pond, Stream, or Lake Discovery Book

1. Bring your budding biologists back together to share their discoveries.
2. Collect the students' drawings and view them with the class.
3. Ask the students to group the drawings according to types of organisms. Keep track of the groups on the whiteboard. Group names might include shore plants, submerged plants, emergent plants, floating plants, macroinvertebrates, and vertebrates. Or students may wish to group the organisms according to the various habitats in which they were collected. Plants and animals can also be grouped according to physical characteristics or behaviors. Characteristics used for grouping depend on the purpose of the

grouping.

4 Divide the class into as many groups as the groups of organisms. Give the corresponding set of drawings to each group of students.

5 Each group can then use their set of drawings to create and write a chapter about that type of organism. These chapters can then be incorporated into a class book on the aquatic life found at the lake, pond, or stream ecosystem that the class visited.

6 Have each student create a cover page and title for the book. Students can vote to determine which will be the cover for the class book.

7 Collect and compile the chapters into a book and attach the winning cover. The book can be kept in the classroom or school library and posted on the school website as a reference and guidebook to life in the local water body.

8 You may wish to make a copy of the book for each student, using each student's own cover design for their personal copy.

Wrap-up

1 Review with your students the four basic habitat needs of aquatic animals: food, water, shelter, and space. Ask students to name some examples of food, water, shelter, and space that they might have observed during the water habitat site survey. What role do aquatic macroinvertebrates play in the aquatic ecosystem?

2 Discuss what might happen if one member of the aquatic community disappeared. How might people be affected? Remind students that all the organisms in an ecosystem are connected in a food web.

Assessment Options

1. Observe students working in groups at the site and as they create the book chapters. Assess each group's chapter, group participation, and contributions to class discussion.
2. Have students make a poster or graphic organizer that describes the various sampling methods they used to collect plants and animals at the site. They should also describe the types of organisms found using each method.
3. Have each student choose an organism from one of their drawings and describe the adaptations that help it survive in its watery habitat.
4. Write an article for the school newspaper or website about the field trip and the discovery book created by the class.
5. Assessment options include the Checklist and Rubric on the following pages.

Graphic organizers can take the form of a concept map, tree, star or web showing definitions, attributes, examples, classifications, structures, examples, relationships, and brainstorming. Charts and tables show attributes, characteristics, comparison, and organization. A chain or timeline illustrates processes, sequences, cause and effect, and chronology. Diagrams, charts, and drawings show physical structures, spatial relationships, and concrete objects. Cut and folded paper can be fashioned into flaps that, when lifted, reveal details, definitions, descriptions, or explanations.

Checklists are tools for students and instructors. Checklists involve students in managing their own learning. They help students understand and set learning goals before the lesson begins, and help them monitor their progress during the lesson, ensuring that they meet learning goals and objectives by the end of the lesson. Students can also use checklists to discover areas that may need improvement. Checklists help instructors monitor each student's progress throughout the lesson, facilitating appropriate adjustment of instruction to ensure learning by the end of the lesson. The instructor may wish to have students add several of their own learning goals to the checklist to personalize it, and to accommodate varied learning needs and styles.

Grade

29-32 points = A
Excellent. Work is above expectations.

26-28 points = B
Good. Work meets expectations.

21-25 points = C
Work is generally good. Some areas are better developed than others.

17-20 points = D
Work doesn't meet expectations; it's not clear that student understands objectives.

0-16 points = F
Work is unacceptable.

Water Habitat Site Study Checklist

Possible Points	Points Earned Student	Points Earned Instructor	
6	_____	_____	Student describes three types of sampling equipment: dip nets, bottom sampler (spade, dredge, or shovel), and rake.
6	_____	_____	Student describes how to use the three types of sampling equipment.
3	_____	_____	Student describes types of organisms collected with all three types of sampling equipment.
3	_____	_____	Poster is attractive, legible, and easily seen from a distance.
2	_____	_____	Student can define *aquatic macroinvertebrate*.
2	_____	_____	Student collects aquatic plants, macroinvertebrates, and other animal specimens from a variety of habitat types in a local water ecosystem using a dip net, rake, and bottom-sifting sampling methods.
3	_____	_____	Student draws and describes examples of organisms collected using each sampling method.
3	_____	_____	Student identifies the plants and animals collected with each sampling method using field guides or identification keys.
4	_____	_____	Student groups organism illustrations into different types or categories of organisms and creates and illustrates materials for the discovery book.
Total Points			
32	_____	_____	**Score** _____

Water Habitat Site Study Scoring Rubric

Sampling Methods Poster Criteria	4 Excellent	3 Good	2 Fair	1 Poor	0 Unacceptable
Sampling equipment and use	Illustrations show at least three types of equipment: dip nets, bottom sampler, and rake. Text states how equipment is used.	Illustrations show two types of sampling equipment. Text states how equipment is used.	Illustrations show two types of sampling equipment. Inaccurate description of equipment use.	Illustrations show one type of sampling equipment. Inaccurate description of equipment use.	Doesn't complete illustrations.
Types of organisms collected, by equipment type	Illustrations describe or visually show types of organisms collected with all three types of sampling equipment	Illustrations describe or visually show types of organisms collected with at least two types of sampling equipment.	Illustrations describe or visually show types of organisms collected with at least one type of sampling equipment.	Illustrations lack description of types of organisms collected with sampling equipment.	Doesn't complete illustrations.
Materials and design	Illustration attractive, legible, and easily seen from a distance.	Illustration attractive and easy to view.	Illustration hard to read and lacks visual appeal.	Illustration illegible.	Doesn't complete illustrations.

Score _____ (Calculate score by dividing total points by number of criteria.)

Diving Deeper

Extensions

1. Create an aquatic food web using the plants and animals in the pond, stream, or lake discovery book the students created, as well as those organisms from the list of living things students expected to see at the site. Include producers, primary consumers, secondary consumers, herbivores, and carnivores. Refer to **Lesson 1:2—Food Chain Tag**. Remind the students that all living things are interconnected. Have all of the students create a food web by arranging the drawings in the center of the room—if an organism eats another organism, position the two drawings so that one corner of one drawing touches the corner of the other drawing. Connect as many of the organisms as possible! Could people be a part of this food web? What does a food web illustrate? Tape the food web together to display in the classroom, or on a wall in the school where everyone can see what lives in the local pond or stream, and how these organisms are connected.
2. Bring some of the pond water and macroinvertebrates that you collect into the classroom and look at the water and organisms with a microscope. Observe and draw the features of the macroinvertebrates in detail. See if students can find the extremely small and microscopic organisms listed on the **Water Habitat Site Study Check-off Sheet.** Determine which adaptations these organisms have that allow them to eat, and note how they move around in the water. Add a microscopic organisms chapter to the pond, stream, or lake discovery book.
3. Ask students to research and write a one-page paper on the adaptations to life in the water developed by pond or stream macroinvertebrates. (Examples include gills, breathing tubes, suction cups, streamlined or flat body shapes, and the ability to walk on the water.)
4. Investigate the camouflage capabilities and building skills of caddisflies, which use silk to glue small sticks and pieces of rock together to make "armored" case structures for themselves.
5. Have students investigate the differences between the complete metamorphosis that mosquitoes undergo and the incomplete metamorphosis of dragonflies and mayflies.
6. Have your students participate in a local volunteer stream monitoring effort. They'll learn more about how some types of aquatic macroinvertebrates are more sensitive to water pollution, and that others are more tolerant of pollution or degraded conditions (including turbidity and silt, low oxygen levels, and toxins).

For the Small Fry

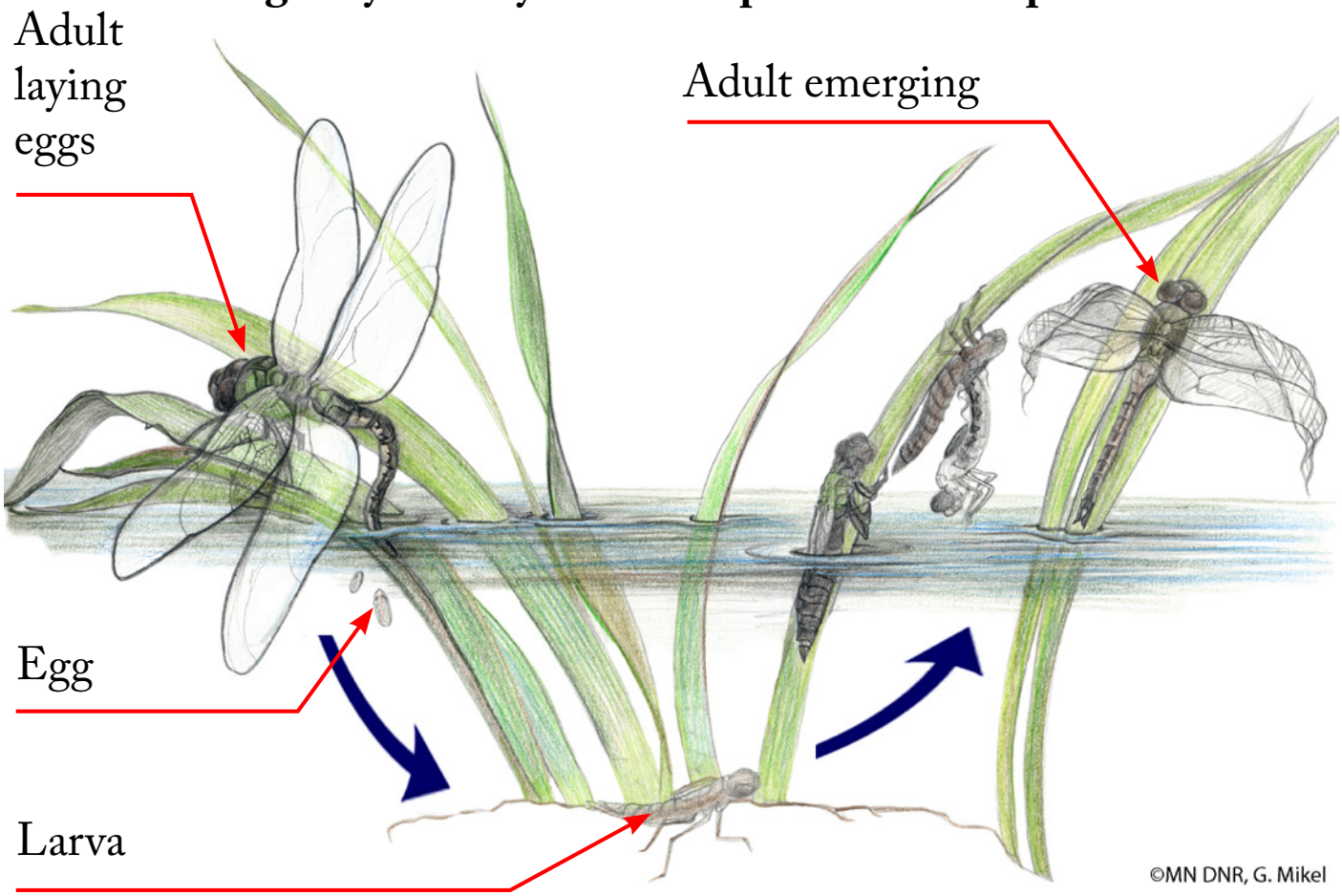
K-2 Option

Instead of making drawings and creating a pond, stream, or lake discovery book, have the student groups play Water Habitat Bingo as they rotate through each station at the site. To play Bingo, ask each group to mark a **Water Habitat Bingo Sheet**, placing an X in each box that names an organism that they find at a station. Four Xs in a row indicate a bingo! Allow students to rotate through the stations until one team gets a bingo and wins the game.

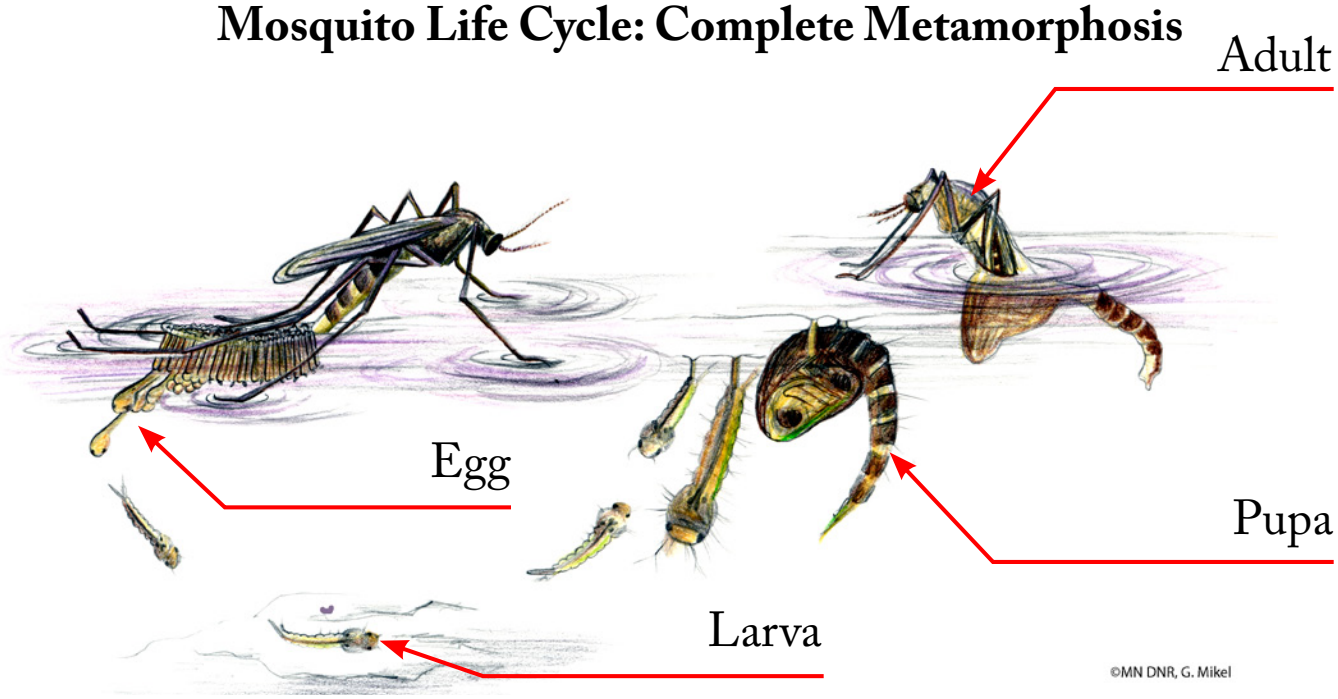
STUDENT COPY

Aquatic Insect Life Cycle Sheet

Dragonfly Life Cycle: Incomplete Metamorphosis



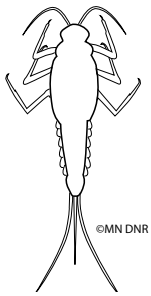
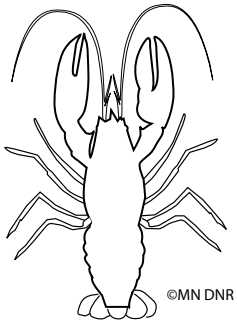
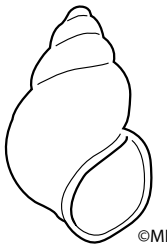
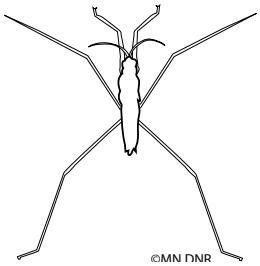
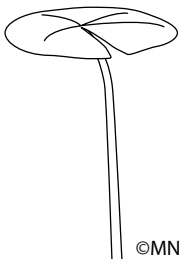
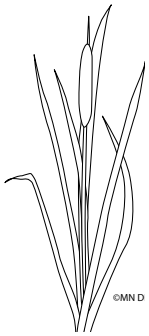
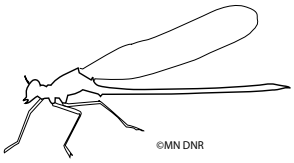
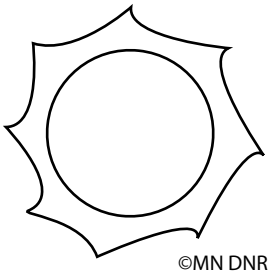
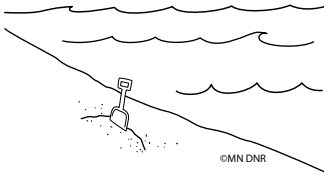
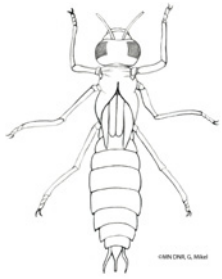
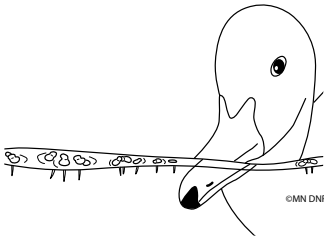
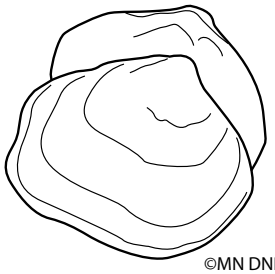
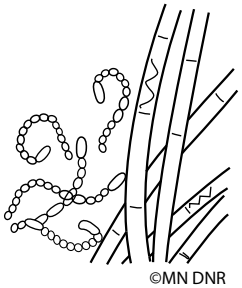
Mosquito Life Cycle: Complete Metamorphosis



STUDENT COPY

Name(s) _____ Date _____

Water Habitat Bingo Sheet (for K-2)

Mayfly larva 	**Crayfish** 	**Snail shell** 	**Water strider** 
Arrowhead 	**Lily pad** 	**Cattail** 	**Small fish** 
Adult damselfly 	**Sun** 	**Water** 	**Dragonfly larva** 
Tadpole 	**Duckweed** 	**Mussel** 	**Algae** 

STUDENT COPY

Name(s) _____ Date _____

Water Habitat Site Study Check-off Sheet

Macroinvertebrates

- ____ Dragonfly
- ____ Damselfly
- ____ Caddisfly
- ____ Mayfly
- ____ Stonefly
- ____ Scud
- ____ Fairy Shrimp
- ____ Water Boatman
- ____ Backswimmer
- ____ Predaceous Diving Beetle
- ____ Whirligig Beetle
- ____ Water Strider
- ____ Mussel shell
- ____ Snail shell
- ____ Crayfish
- ____ Water Scorpion
- ____ Giant Water Bug
- ____ Leech

Vertebrates: Reptiles and Amphibians

- ____ American Toad
- ____ Bullfrog
- ____ Chorus Frog
- ____ Green Frog
- ____ Leopard Frog
- ____ Newt
- ____ Painted Turtle
- ____ Tiger Salamander larva
- ____ Spring Peeper
- ____ Tadpole

Vertebrates: Fish

- ____ Fathead Minnow
- ____ Creek Chub
- ____ Northern Redbelly Dace
- ____ Bluntnose Minnow
- ____ Darter
- ____ Brook Stickleback
- ____ Mudminnow
- ____ Killifish
- ____ Sunfish
- ____ Black Bullhead
- ____ Golden Shiner

STUDENT COPY

Name(s) _____ Date _____

Water Habitat Site Study Check-off Sheet

Aquatic Plants

_____ Wild Celery

_____ Common Waterweed

_____ Large-leaf Pondweed

_____ Northern Watermilfoil

_____ Eurasian Watermilfoil
(invasive species)

_____ Coontail

_____ Curlyleaf Pondweed
(invasive species)

_____ Small Duckweed

_____ Large Duckweed

_____ White Water Lily

_____ Yellow Water Lily

_____ Yellow Lotus

_____ Arrowhead

_____ Soft-stem or Hard-stem Bulrush

_____ Common Rush

_____ Cattail

_____ Northern Blue Flag Iris

_____ Wild Rice

_____ Purple Loosestrife
(invasive species)

Other Aquatic Plants or Animals

_____

_____

_____

_____

_____

_____

_____

_____

_____

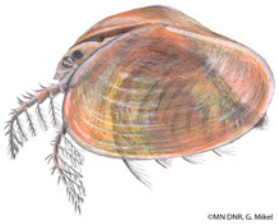
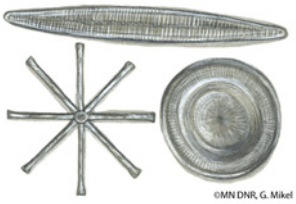
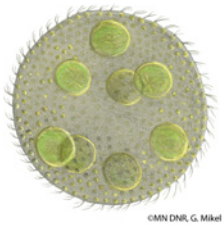
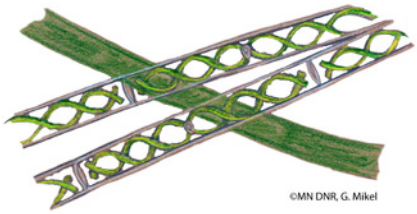
STOP AQUATIC HITCHHIKERS!

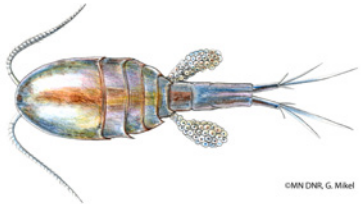
Prevent the transport of nuisance species.
Clean all recreational equipment.

STUDENT COPY

Name(s) _____ Date _____

Water Habitat Site Study Check-off Sheet

X	Microscopic Organisms
	 Clam or Seed Shrimp
	 Diatom
	 Volvox
	 Euglena
	 Spirogyra
	 Rotifer

X	Microscopic Organisms
	 Hydra
	 Cyclops/Copepod
	 Daphnia
	 Paramecium
	 Amoeba

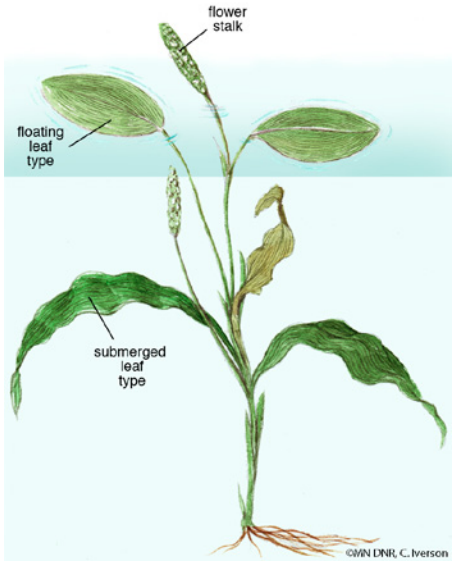
Water Habitat Site Study Identification Sheet: Plants

Submerged Plants

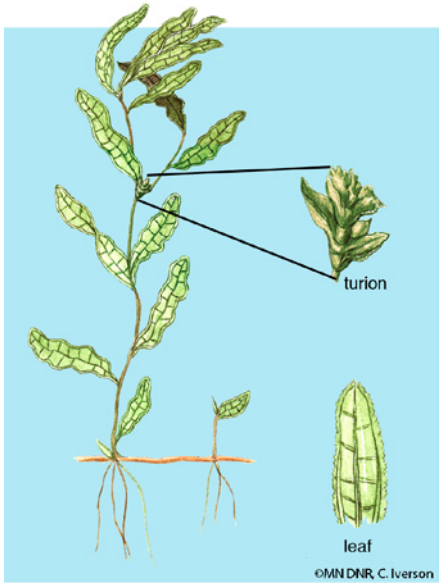
Entire leaves: opposite or whorled

Common Waterweed
Elodea Canadensis

Entire leaves: alternate or basal



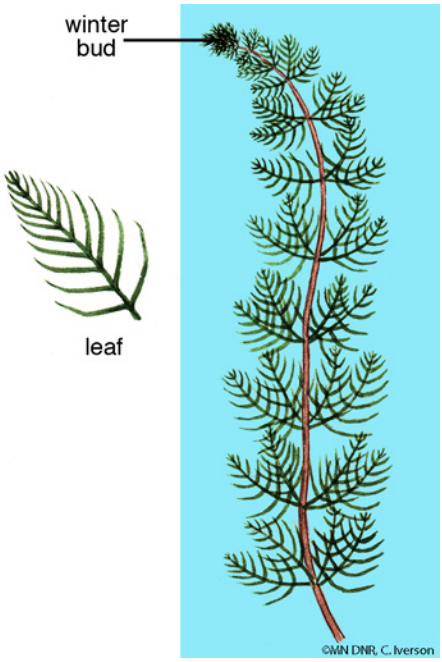
Large-leaf Pondweed
Potamogeton amplifolius



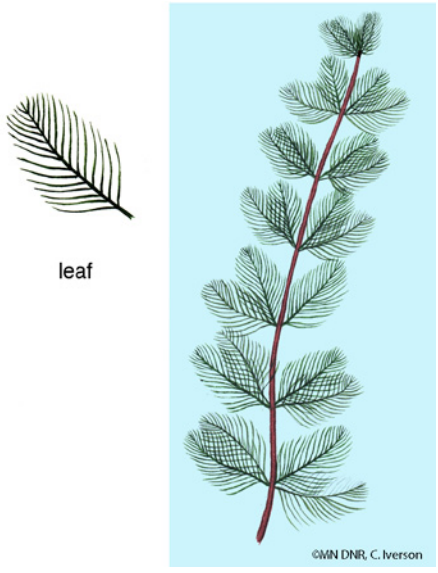
Curly-leaf Pondweed
Potamogeton crispus
(Invasive Species)

Wild Celery
Vallisneria Americana

Finely-divided leaves



Northern Water Milfoil
Myriophyllum sibiricum

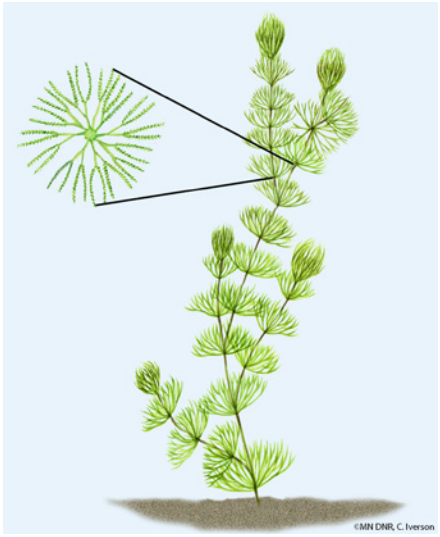


Eurasian Water Milfoil
Myriophyllum spicatum
(Invasive Species)

Water Habitat Site Study Identification Sheet: Plants

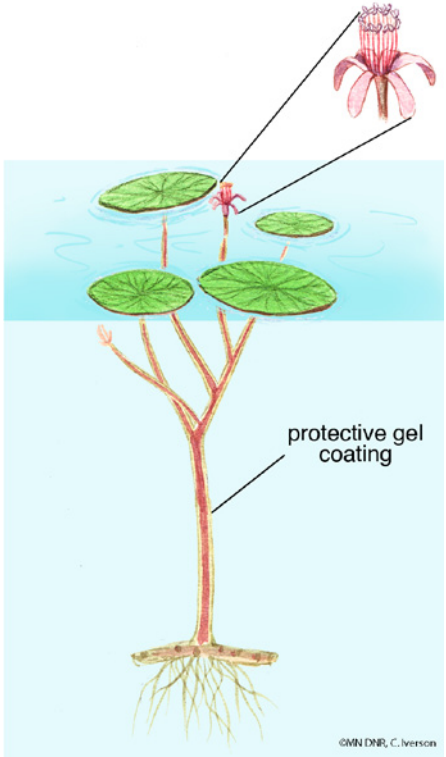
Submerged Plants

Finely-divided leaves



Coontail
Ceratophyllum demersum

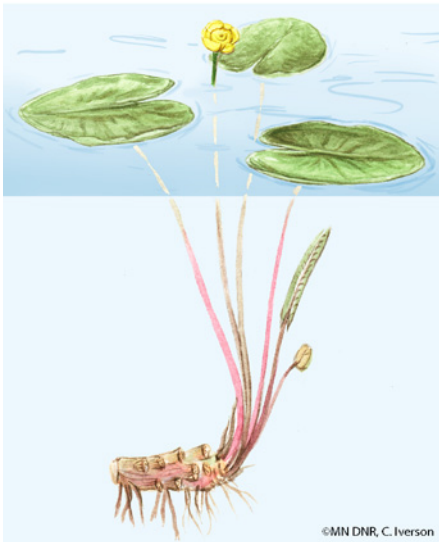
Floating-leaf Plants



Watershield
Brasenia schreberi

American Lotus
Nelumbo lutea

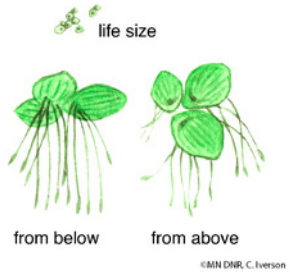
White Water Lily
Nymphaea odorata



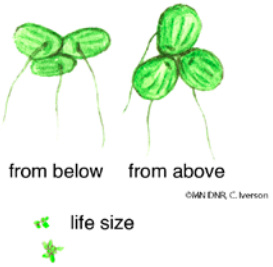
Yellow Pond lily
Nuphar advena

Water Smartweed
Polygonum amphibium

Free-floating Plants



Large Duckweed
Spirodela polyrhiza

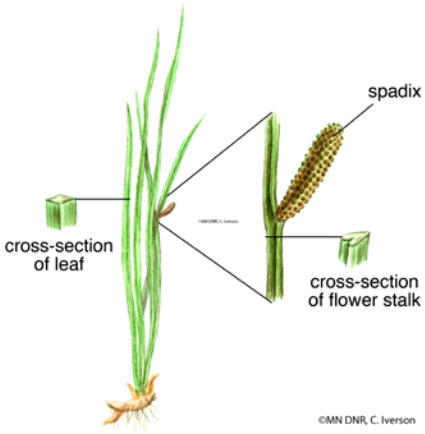


Small Duckweed
Lemma minor

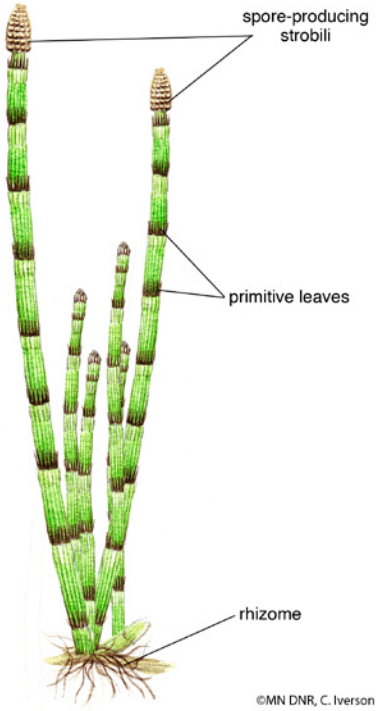
Water Habitat Site Study Identification Sheet: Plants

Emergent Plants

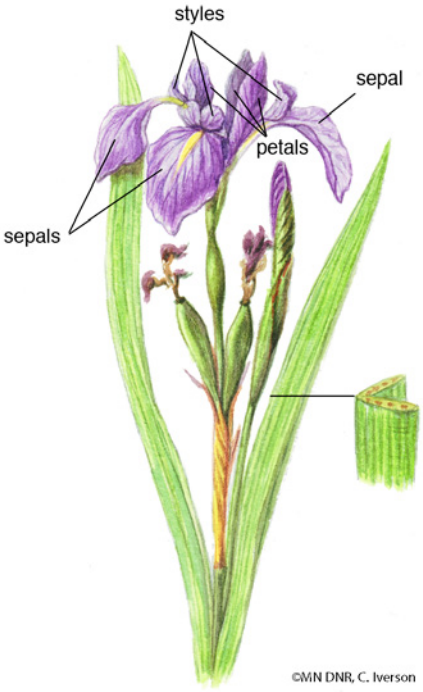
Narrow leaves



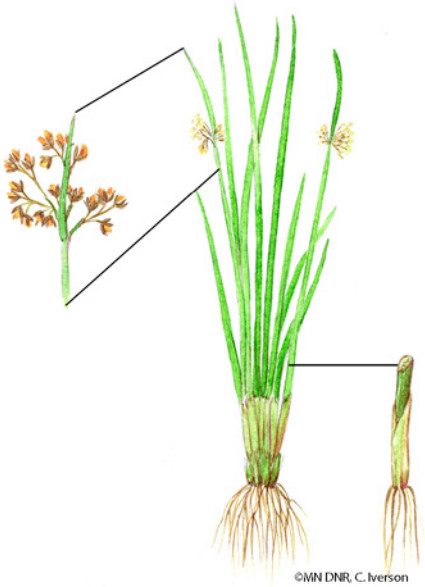
Sweetflag
Acorus calamus



Water Horsetail
Equisetum fluviatile

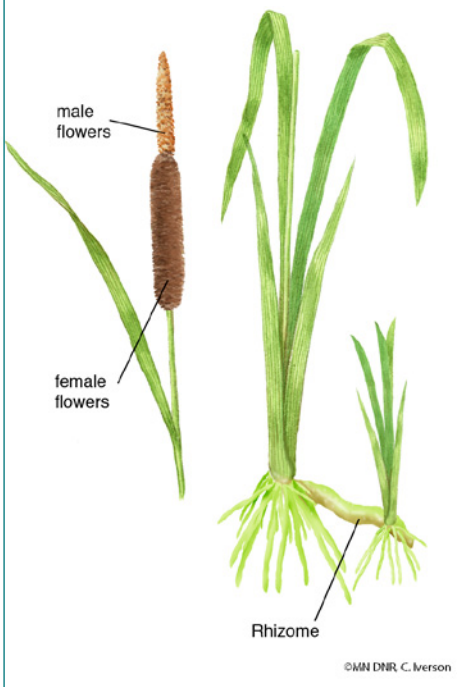


Northern Blue Flag Iris
Iris versicolor



Common Rush
Juncus effusus

Hardstem Bulrush
Scirpus acutus

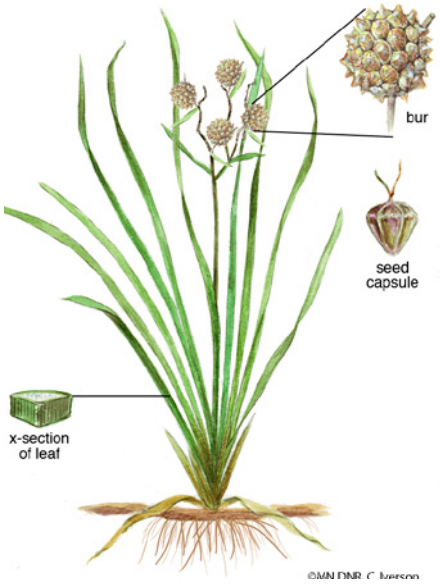


Broad-leafed Cattail
Typha latifolia

Water Habitat Site Study Identification Sheet: Plants

Emergent Plants

Narrow leaves



Common Bur-reed
Sparganium eurycarpum

Common Reed
Phragmites australis

Wild Rice
Zizania spp.

Softstem Bulrush
Scirpus validus

Water Habitat Site Study Identification Sheet: Plants

Emergent Plants

Broad leaves

Common Arrowhead
Sagittaria latifolia

Pickerelweed
Pontederia cordata

Purple Loosestrife
Lythrum salicaria
(Invasive Species)

Water Hemlock
Cicuta maculata

Wild Calla
Calla palustris

Water Habitat Site Study Identification Sheet: Reptiles and Amphibians

Frogs

Bullfrog*
Rana catesbeiana

Bullfrog Tadpole
Rana catesbeiana

Chorus Frog
Pseudacris triseriata

Green Frog
Rana clamitans

Leopard Frog
Rana pipiens

Spring Peeper
Pseudacris crucifer

Toads

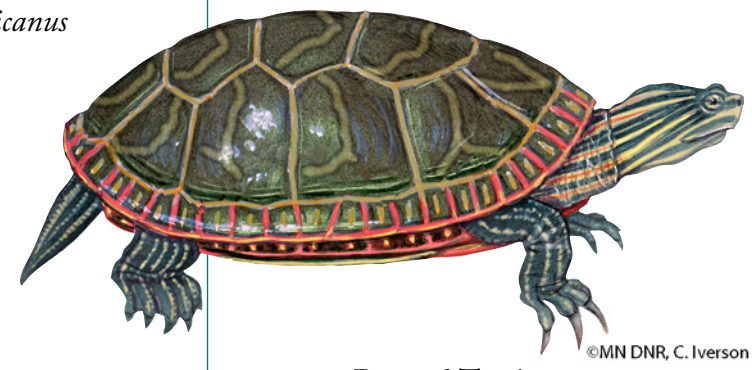
American Toad
Bufo americanus

Salamanders

Eastern Tiger Salamander
Ambystoma tigrinum

Eastern Tiger Salamander Larva
Ambystoma tigrinum tigrinum

Turtles



Painted Turtle
Chrysemys picta bellii

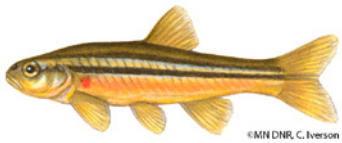
* Note: native only to southeast Minnesota.

Water Habitat Site Study Identification Sheet: Fish

Minnow Family

Fathead Minnow
Pimephales promelas

Creek Chub
Semotilus atromaculatus



Northern Redbelly Dace
Phoxinus eos

Bluntnose Minnow
Pimephales notatus

Golden Shiner
Notemigonus crysoleucas

Perch Family

Johnny Darter
Etheostoma nigrum

Stickleback Family

Brook Stickleback
Culaea inconstans

Mudminnow Family

Central Mudminnow
Umbra limi

Killifish Family

Banded Killifish
Fundulus diaphanus

Sunfish Family

Bluegill
Lepomis macrochirus

Catfish Family

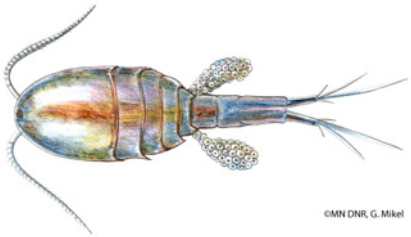
Black Bullhead
Ameiurus melas

Water Habitat Site Study Identification Sheet: Microscopic Organisms

Zooplankton

Amoeba

Clam Shrimp
(Conchostraca)

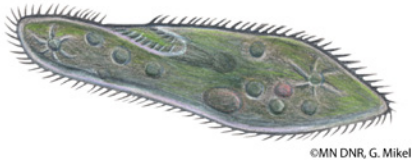


Cyclops / copepod

Daphnia / water flea
(Cladocerans)

Euglena
(Mastigophora; motile
unicellular algae)

Hydra



Paramecium
(Ciliophora)

Rotifer

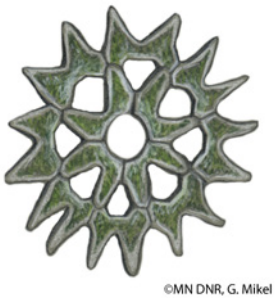
Seed Shrimp
(Ostracoda)

Stentor
(Ciliophora)

Water Habitat Site Study Identification Sheet: Microscopic Organisms

Phytoplankton

Anabaena
(planktonic blue-green algae)

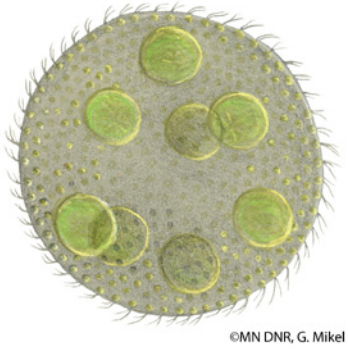


Pediastrum

Chara
(plant-like algae)

Spirogyra
(filamentous green algae)

Diatom (hard-sided
phytoplankton)



Volvox
(Mastigophora; colonial algae)

Identification Key #1

Shells

Single Shell

spiral, opening on left

Pouch Snail

spiral, opening on right

Gilled Snail

coiled

Orb Snail

Double Shell

small, whitish, tan, or brown

Pill or Fingernail Clam

(Actual Size: 10mm)

large, 2 to 8 inches, dark-colored

Freshwater Mussel

No Shells

Without Backbone (Invertebrates)

Legs

Ten or More Legs

lobster-like

Crayfish

rust-colored spots; invasive species

Rusty Crayfish

(Invasive Species)

pinkish, feathery

Fairy Shrimp

(Actual Size: 15mm)

shrimp-like, swims on side

Scud or Amphipod

(Actual Size: 15mm)

walks on bottom

Aquatic Sowbug or Isopod

Four Pairs of Legs

runs on top of water

Fishing Spider

Three Pairs of Legs

No Wings
Go to Key 3

Wings
Go to Key 4

No Legs
Go to Key 2

With Backbones (Vertebrates)
Go to Fish ID Sheet and to Reptiles and Amphibians ID Sheet

Macroinvertebrate keys based on the work of University of Wisconsin-Extension, the Wisconsin Department of Natural Resources, and the Riveredge Nature Center, Newburg Wisconsin

Identification Key #2

No Legs

Microscopic
Go to Microscopic ID Sheet

Wormlike

With Tentacles, Brushes, or Tails

suckers, expands and contracts

Leech

reddish brown

Tubiflex Worm

glides along bottom

Flatworm or Planaria

tan to brown, long

Horsehair Worm

small, hairlike, swims in S shape

Nematode or Threadworm

breathing tube at rear

Mosquito Larva

large head, wriggles

Mosquito Pupa
(Actual Size:
18mm)

on surface, stiff, with tail disk

Soldier Fly Larva

long breathing tube

Rat-tailed Maggot Larva
(Actual Size:
16mm)

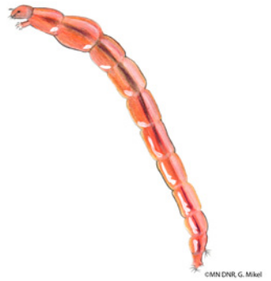
smooth, stiff, small head

Horsefly Larva

white or grey, with tentacles

Cranefly Larva

red, green, or tan; twists



Midge Larva
(Actual Size:
20mm)

big "head," active

Midge Pupa
(Actual Size:
20mm)

small, black, attaches to rocks

Blackfly Larva
(Actual Size:
8mm)

Macroinvertebrate keys based on the work of University of Wisconsin-Extension,
the Wisconsin Department of Natural Resources, and the Riveredge Nature Center, Newburg Wisconsin

Identification Key #3

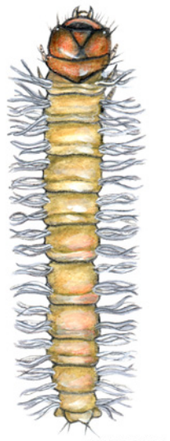
No Wings (Wing Pads May Be Present)

No Obvious Tails

brown, featherlike, usually six legs, C-shaped

Riffle Beetle Larva
(Actual Size: 8mm)

six legs and prolegs on abdomen



Pyrallid Caterpillar

suction cup-like

Water Penny
(Actual Size: 10mm)

large body, hinged mouth

Dragonfly Larva

lives in stone or stick case; green, tan, orange, or white body

Caddisfly Larva

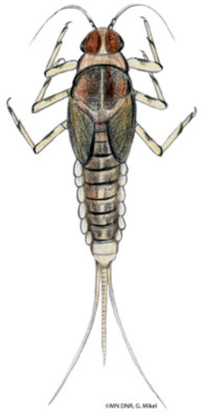
moves slowly; abdomen blunt, round on end; thick jaws

Water Scavenger Beetle Larva

One or Two Tails

Three Tails

long tails, gills on abdomen



Mayfly Larva

plate-like tails, no gills on abdomen

Damselfly Larva

One or Two Tails

4 hooks on last segment, body creamy white

Whirligig Beetle Larva

small, "spines" on side

Alderfly Larva

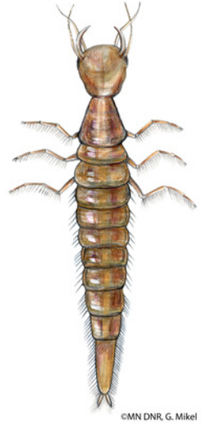
large mouthparts, "spines" on side

Dobsonfly Larva

tails long and stiff

Stonefly Larva

hangs from surface, large mouth parts



Predaceous Diving Beetle Larva

small, hops on surface

Springtail
(Actual Size: 2mm)

Macroinvertebrate keys based on the work of University of Wisconsin-Extension,
the Wisconsin Department of Natural Resources, and the Riveredge Nature Center, Newburg Wisconsin

Identification Key #4

Wings

Leathery Wings

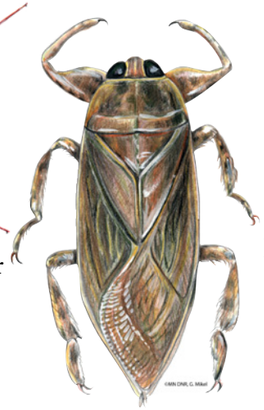
tan, lives on surface

Marsh Treader

dark, lives on surface

Water Strider

grasping front legs, up to three inches



Giant Water Bug

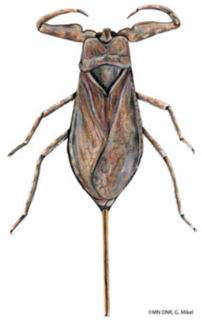
swims on back, back white

Backswimmer

swims right-side up, black back

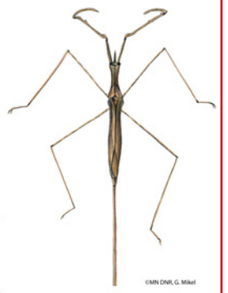
Water Boatman

long breathing tube, grasping front legs



Water Scorpion (*Nepa*)

long, stick-like



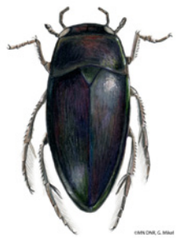
Water Scorpion (*Ranatra*)

Paper-like Wings

small, crawls on bottom

Riffle Beetle
(Actual Size: 8mm)

swims moving hind legs alternating



Water Scavenger Beetle

back legs move at same time

Predaceous Diving Beetle

swims on surface

Whirligig Beetle

"crawls" through water, spotted

dorsal

ventral

Crawling Water Beetle
(Actual Size: 6mm)

Hard Shell Wings

elongate wing extends past abdomen

Alderfly Adult

mothlike; wings tent body

Caddisfly Adult

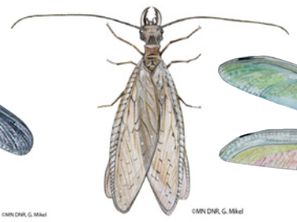
looks like giant mosquito

Cranefly Adult

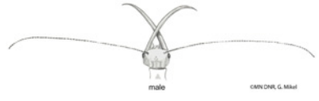
wings extend above body

Damselfly Adult

elongate wing extends past abdomen



Dobsonfly Adult Female



male

Dobsonfly Adult Male (head)

abdomen long and stout

Dragonfly Adult

three long, thin tails

Mayfly Adult

large feathery antennae

Midge Adult
(Actual Size: 14mm)

two thin tails

Stonefly Adult

Macroinvertebrate keys based on the work of University of Wisconsin-Extension, the Wisconsin Department of Natural Resources, and the Riveredge Nature Center, Newburg Wisconsin