

Freshwater Classification

Grade Level(s): 3-5
Time: 40-60 minutes
Group Size: 20-30

Summary

Students will be introduced to several invertebrate and vertebrate species in a freshwater ecosystem. By observing living samples of macroinvertebrates, students will learn about the classification system. Students will also learn 3-5 local freshwater fish species and the relationship between fish and invertebrates.

Objectives

After this presentation, students will be able to:

- Identify invertebrate and vertebrate species in a freshwater ecosystem
- Compare and contrast invertebrate and vertebrate organisms
- Characterize invertebrates in a freshwater ecosystem

Materials

- 1 10-15 foot seine net
- 1-2 scap nets
- Buckets or large plastic bin
- Aerator
- Waders
- 10-15 Petri dishes
- 10-15 hand-held lenses
- 10-15 hand-held dip nets
- 2 semi-deep collection trays/pond
- Box of plastic spoons
- 10-15 pipettes
- 10 laminated *Freshwater Organism Classification worksheet*
- 8-10 copies of *Freshwater Organism Identification worksheet*
- Small-medium plastic containers
- Freshwater fish mounts/pictures

NYS Learning Standards Core Curriculum MST

Standard 1: Analysis, Inquiry, and Design

Students will: use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

- *Key Idea 1:* The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

Standard 4: Living Environment

Students will: understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

- *Key Idea 1:* Living things are both similar to and different from each other and non-living things.
- *Key Idea 6:* Plants and animals depend on each other and their physical environment.

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Live Animals

NYSDEC staff does not bring any dangerous organisms into the classroom. We will handle any organisms professionally, and ensure the safety of the students. The instructor will set rules for observations before organisms are distributed. We will bring in a variety of macro invertebrates.

Vocabulary

- **Aquatic Macroinvertebrate-** small aquatic organism, visible to the naked eye
- **Bioindicator-** organism that assess environmental conditions of an area
- **Caudal/Tail Fin-** fin on end of fish; used to propel the fish
- **Complete Metamorphosis-** four stages of development; involves pupa stage where the change to adult occurs
- **Dorsal Fin-** backside fin on a fish; used for balance and protection
- **Ecosystem-** community of organisms and their environment; working together
- **Gills-** organ a fish uses to obtain oxygen from the water
- **Heterotroph-** a consumer, organism that can't make its own food
- **Incomplete Metamorphosis-** three stages of development; larva looks like adult
- **Indicator Species-** a species whose presence, absence, or abundance reflects a specific environmental condition
- **Invertebrate-** organism without a backbone
- **Lateral Line-** organ a fish uses to "feel" low vibrations; tiny pores
- **"Match the Hatch"-** selecting the bait that most closely resembles the prey species fish are feeding on at that time of year.
- **Nares-** organ a fish uses to smell; similar to nostrils
- **Omnivore-** organism that eats both plants and animals
- **Predator-** organism that preys upon or eats another organism
- **Prey-** organism that a predator is targeting or organism that is being eaten
- **Taxonomic Classification-** a hierarchical systematic arrangement in which organisms are classified into groups based on their similarities
- **Vertebrate-** organism with a backbone

Background

Classification

Using a system of classification, scientists arrange all organisms into groups based on their similarities. Carolus Linnaeus proposed the first system of classification in 1753. Linnaeus believed that each organism should have a binomial name, genus and species, with species being the smallest organization unit of life. Using Linnaeus' system as a guide, scientists created a hierarchical system known as **taxonomic classification**, in which organisms are classified into groups based on their similarities. This hierarchical system moves from largest and most general to smallest and most specific: kingdom, phylum, class, order, family, genus, and species.

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Aquatic **invertebrates** are small organisms without backbones found in freshwater or saltwater. There are two types of invertebrates: micro and macro. **Macroinvertebrates** are those organisms that you can see with the naked eye, whereas micro-invertebrates are those organisms that you need a microscope to see. Both types of aquatic invertebrates live in many different habitats, e.g., under stones, and buried in sediment, woody debris, hot springs, shallow ponds, and deep lakes. Some more tolerant, less-sensitive invertebrates can live in higher salinity or polluted waters. Aquatic invertebrates are **heterotrophs** meaning they cannot make their own food. Some are **omnivores**; they eat plants, other invertebrates, and, in some cases, small fish. Many aquatic invertebrates are predators, and some are strictly herbivores.

Life Cycle

Many aquatic macroinvertebrates are insects, such as dragonflies or damselflies, and begin their lives in the water. These organisms may spend over a year in the water, encompassing most of their lives. For example, an adult dragonfly spends only 1-3 months out of the water.

Metamorphosis is the change that occurs during the organism's development from egg to adult. Aquatic insects move through two different types of growth, incomplete or complete metamorphosis. **Incomplete metamorphosis** involves three stages of growth: egg → nymph → adult. These invertebrates go through a series of molt or skin sheds until they reach adult size. During **complete metamorphosis**, larvae do not look like adults and there are four stages of growth: egg → larva → pupa → adult. During the pupa stage the organism undergoes its transformation from larva to adult.

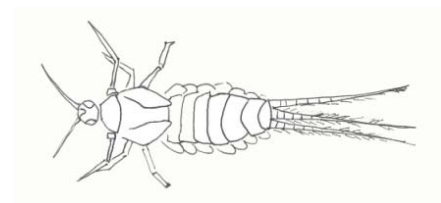
Examples and Fun Facts

Aquatic invertebrates are quite diverse. Macroinvertebrates come in all shapes and sizes. Leeches, snails, clams, water penny beetles, may flies, black flies, and crayfish are just a few examples of common freshwater macroinvertebrates. Each macroinvertebrate species is unique. Did you know that?

- some dragonflies can fly up to 30 mph
- crayfish can swim forwards, backwards, and sideways
- a digestive system runs through the tail of both the dragonfly and the damselfly
- there are more than 700 different types of mayflies in North America
- dragonflies have been around for over 300 million years
- immature mayflies have gills along the sides of their body
- snails can live from 9-15 years

Indicator Species

Although small, aquatic invertebrates are very important to an ecosystem, not only with respect to the food web, but they also help assess environmental conditions of an area. Specifically, they serve as an indicator of watershed health, and are sometimes referred to as **indicator species**. For example, mayflies and stoneflies, if found, are indicators of good water quality. In contrast, leeches and worms are indicators of poor water conditions.



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Many aquatic invertebrates are good indicators of water quality because they:

- live in the water for all or most of their life
- stay in areas suitable for their survival
- are easy to collect
- differ in their tolerance to amount and types of pollution
- are easy to identify in a laboratory
- often live for more than one year
- have limited mobility

External Anatomy of a Fish

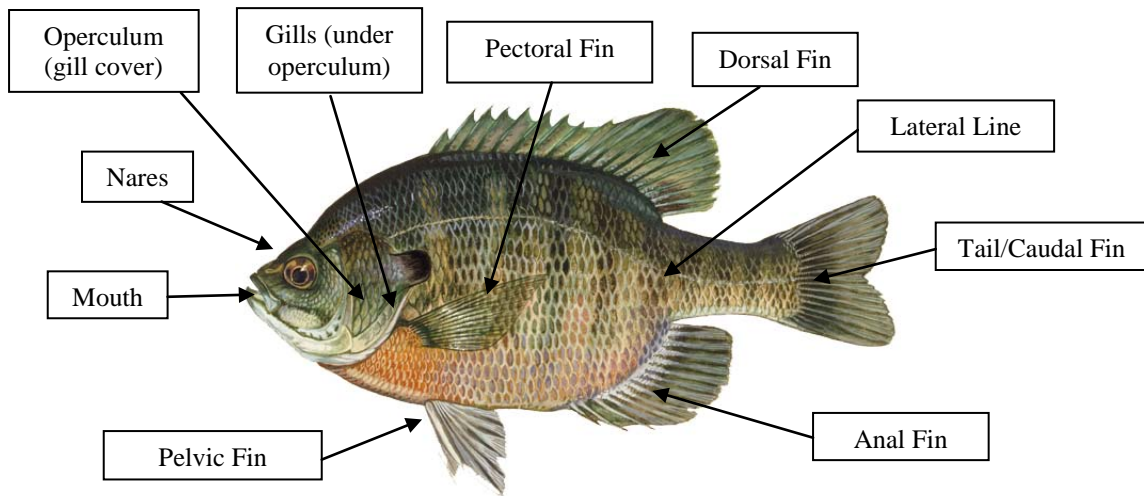


Illustration by Duane Raver

Set up

Pre-Lesson Procedures

Seining

Obtain a License to Collect or Possess * Go seining at a local fresh body of water.

1. Store a diversity of organisms in buckets with an aerator, a large plastic bin, or a small water jug.

At School

1. Set up the “classroom pond” by pouring some of the pond water into the collection trays.
2. Set up and distribute the Petri dishes, small-medium plastic containers, pipettes, spoons, and *Classification worksheets*.

Please Note

Before you go seining, make sure to obtain a NYSDEC License to Collect or Possess. Download the application at <http://www.dec.ny.gov/permits/28633.html>. Send the application with a \$10 check or money order to the DEC Special Licenses Unit. This license can apply to more than one instructor or school. Make sure to attach a list of names/addresses of people to be included on the license.

Main Activity

Introduction

1. Introduce yourself
2. Introduce the day's activities:
 - a. The freshwater environment
 - b. Invertebrate and vertebrate identification

Freshwater Introduction

1. Define freshwater. Have students brainstorm a few local examples.

Pond Study

Tell students they are scientists studying invertebrates and vertebrates found in a “classroom pond” or a freshwater ecosystem.

1. Discuss the differences between invertebrates and vertebrates.
 - a. Say: What is a vertebrate?
2. Begin by focusing on invertebrates.
3. Have students work in groups of three. Provide each group with the following supplies: pipette; Petri dish; *Freshwater Organism Identification worksheet*; plastic spoon; and hand lens.
4. Have each group work together to identify two invertebrates. Assign a different task to each member of each group:
 - a. Scientist #1 collects the organism
 - b. Scientist #2 describes and draws the organism
 - c. Scientist #3 records answers on the *Identification worksheet*
5. Begin the first round of collections by demonstrating how to collect organisms using the dip net; then let students practice the procedure using a net and plastic container.
6. After the collection process is complete, have all scientists work on identifying their invertebrate.
7. Circulate among students during identification process. Field questions and offer suggestions.
8. When finished, start a second round of collections. Have students switch roles.
9. Time permitting, run a third round of collections. Again, have students switch roles.
10. After the students have finished, ask each group to identify the critters found.

Vertebrate Identification

1. Show the students 3-5 different freshwater fish species.
 - a. Discuss external anatomy features, proper handling, and the five senses.
2. Have students complete back of *Identification worksheet*. Review answers together.

Big Picture

Discuss relationships between invertebrates and vertebrates in the freshwater environment. Introduce the terms, “predator” and “prey.”

- a. Say: How are these two types of organism similar? How are they different?

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- b. Say: Could invertebrates and vertebrates in a freshwater environment depend on each other? How?

Wrap up

Relation to Fishing

Understanding the relationship between vertebrates and invertebrates in the aquatic food web helps us as to understand what fish eat. This allows us to “*match the hatch*” when fishing, which means to select a bait that best imitates the prey species fish are feeding on. Many invertebrate species are also indicators of water quality. By being able to identify common macroinvertebrates and understand their role as indicator species, we can make our own inferences about the health of a water body.



Review

- Have students identify the invertebrate and/or vertebrate species they observed
- Ask the students to compare and contrast invertebrate and vertebrate organisms
- Have students explain the characteristics of their invertebrate or vertebrate that helped them to properly identify the species (number of legs, tail (s) shape, body shape)

Questions for Discussion

Q: What is the difference between a vertebrate and an invertebrate?

A: vertebrates have a backbone and internal skeletal system, invertebrates are organisms without a backbone or internal skeletal system.

Q: Can you see macroinvertebrates with the naked eye?

A: yes!

Q: Where do aquatic macroinvertebrates live?

A: Some spend only part of their lives in the water and will eventually crawl out, while some live their entire lifecycle in the water.

Q: What do invertebrates eat?

A: Predators: smaller invertebrates, plankton, sometimes fish or tadpoles
Grazers: algae on rock,
Shredders: dead leaves

Q: Name a type of macroinvertebrate

A: mayfly, stonyfly, leech, maggot

Q: Name a freshwater fish species that you could catch locally

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A: largemouth bass, bluegill sunfish, pumpkinseed sunfish, perch, chain pickerel, brown bullhead catfish, rainbow trout, brown trout, brook trout

Q: What do you call an organism that eats invertebrates?

A: predator

Q: Macroinvertebrates are good indicators of water quality because_____?

A: Answers can vary. Macroinvertebrates: live in the water for all or most of their life stay in areas suitable for their survival, are easy to collect, differ in their tolerance to amount and types of pollution, are easy to identify in a laboratory, often live for more than one year, have limited mobility

Q: How do scientists classify macroinvertebrates into groups?

A: Based on their similarities, invertebrates are tiny organisms without an internal skeletal system.

For additional assessment, have students fill out the *Identification Worksheet* as is.

Related Materials

Dichotomous Keys to Macroinvertebrates, NYSDEC

http://www.dec.ny.gov/docs/administration_pdf/lppondidentifykey.pdf

NYSDEC key for common macroinvertebrate species, identification page, and glossary

Web Resources

Macroinvertebrate Ecology, Maryland Department of Natural Resources.

<http://www.dnr.state.md.us/education/envirothon/aquaticinsectecology.pdf>

Provides background information on macroinvertebrate classification, life cycles, adaptations, anatomy, and sampling methods

“Freshwater Macroinvertebrates of NY,” NYSDEC.

<http://www.dec.ny.gov/animals/35772.html>

Provides photos and information on a variety of aquatic macroinvertebrates

“Freshwater Fishes,” NYSDEC.

<http://www.dec.ny.gov/animals/269.html>

NYSDEC site providing information on a variety of species, with over ten series on fish including: true bass, common minnows, common prey fish, sunfish, and trout.

Pond Ecology Lesson Plan Grades 4-6, NYSDEC.

<http://www.dec.ny.gov/education/73664.html>

NYSDEC Department of Public Affairs and Education Pond Ecology Lesson Plan appropriate for grades 4-6.

Biodidac: Digital resources for teaching biology.

<http://biodidac.bio.uottawa.ca/info/browse.htm>

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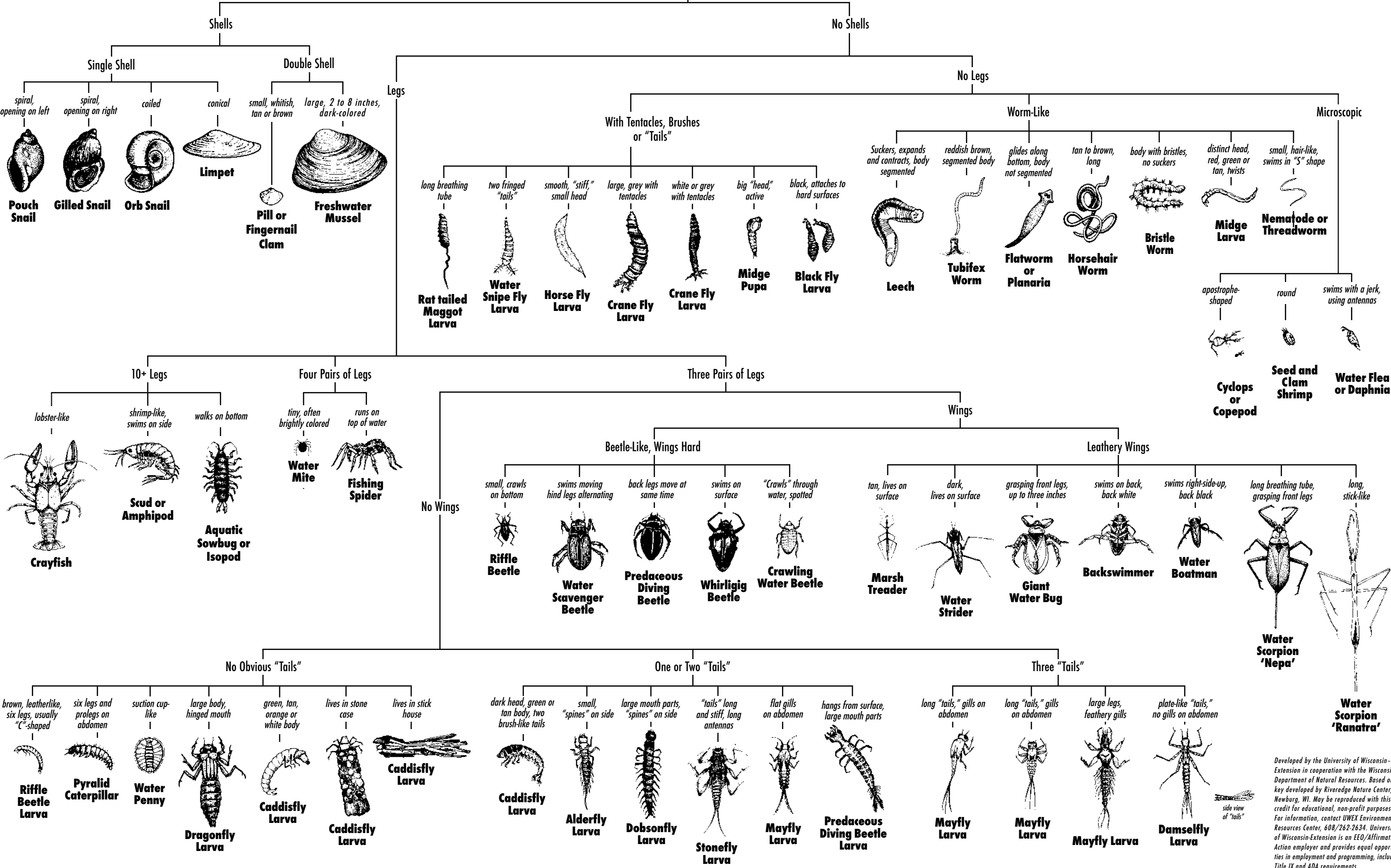
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Online resource for illustrations of animals, plants, bacteria, and human anatomy



Key to Macroinvertebrate Life in the River

(Sizes of illustrations are not proportional.)

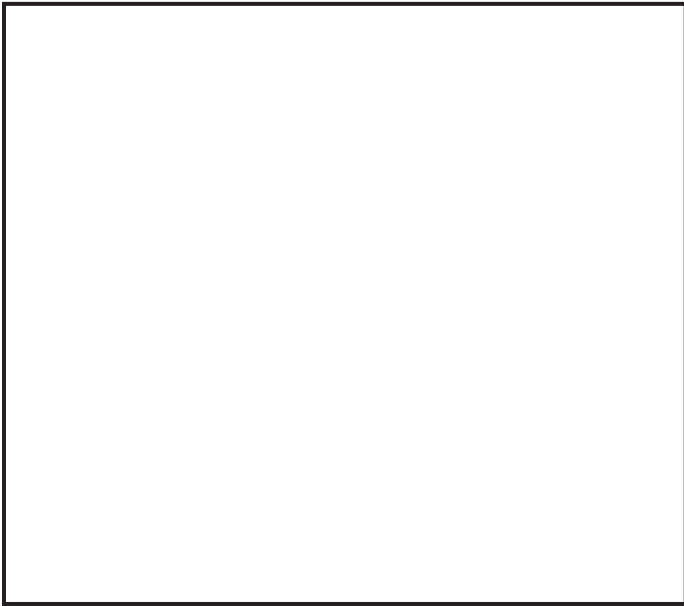


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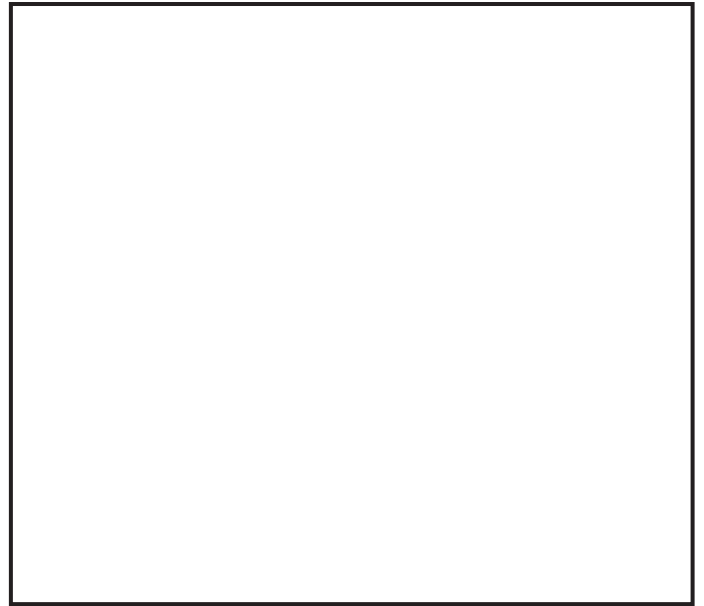
Identifying Invertebrates in the Freshwater Environment

Scientist Names:

Draw Two Different Invertebrates:



Sample 1



Sample 2

Describe the Invertebrates:

What is its shape?

Sample 1:

Sample 2:

How many legs does it have?

Sample 1:

Sample 2:

How does it move?

Sample 1:

Sample 2:

Can it protect itself from being eaten? How do you think?

Sample 1:

Sample 2:

Name the Invertebrates: (Hint-use the key provided)

Sample 1:

Sample 2:



Identifying Vertebrates in the Freshwater Environment

Who am I?



Hint: I have a very large mouth and swallow my food whole.

I am a _____

Who am I?



Hint: What do you carve at Halloween time? How small is a seed?

I am a _____

Who am I?



Hint: I am the New York State freshwater fish.

I am a _____

FRESHWATER MACROINVERTEBRATES

Without realizing it, you have probably seen a macroinvertebrate before. They are often called bugs or insects. For a better understanding, it helps to breakdown the word: “macro” is something that is small, but can be seen with the naked eye, and an “invertebrate” is an organism that does not have a backbone. Bugs and insects are important aspects to an environment. They provide a food source for many different organisms, such as fish. Use the identification key to find out what freshwater organism you have found!



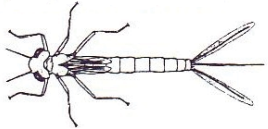
Water Beetle Larvae



Clam



Water Strider



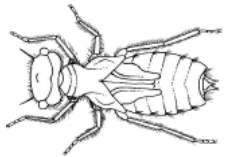
Damselfly Nymph



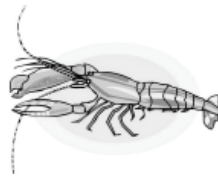
Snail



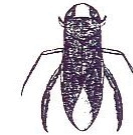
Water Beetle



Dragonfly Nymph



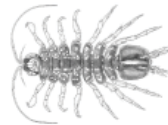
Crayfish



Water Boatman



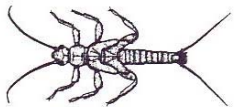
Mayfly Nymph



Isopod



Backswimmer



Stonefly Nymph



Scud



Water Mite



Caddisfly Nymph



Midge, Mosquito
and Fly Larvae



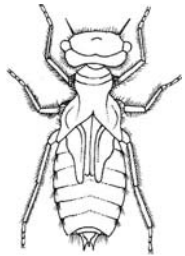
Worms and
Leeches

NYMPHS, LARVAE, AND LIFE CYCLES

Insects or macroinvertebrates go through different stages during their life. Referred to as a life cycle, nymphs and larvae are one stage of the cycle, the baby stage. Sometimes the nymphs or larvae can look exactly like the adult or in other cases, the baby can look completely different. Check out some nymphs and larvae that look nothing like their parents!

DRAGONFLY

Nymph



Adult



MOSQUITO

Nymph



Adult

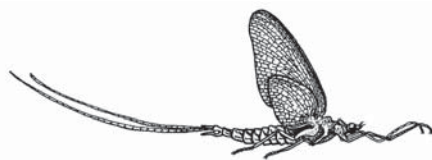


MAYFLY

Nymph



Adult



STONEFLY

Nymph



Adult

