Key Concept Three
Protecting Our Aquatic Resources

Poster Panels, Activities and Essential Learnings for Key Concept Three

Protection and conservation (stewardship) of aquatic ecosystems is essential to sustain plant, animal and human communities into the future.

Poster Panel Reference	Activities
We Need Healthy Streams and Groundwater	
Protecting Nature's Water Needs	16. Yellow Fish Road 17. Make a Waterscope 18. Stream Science

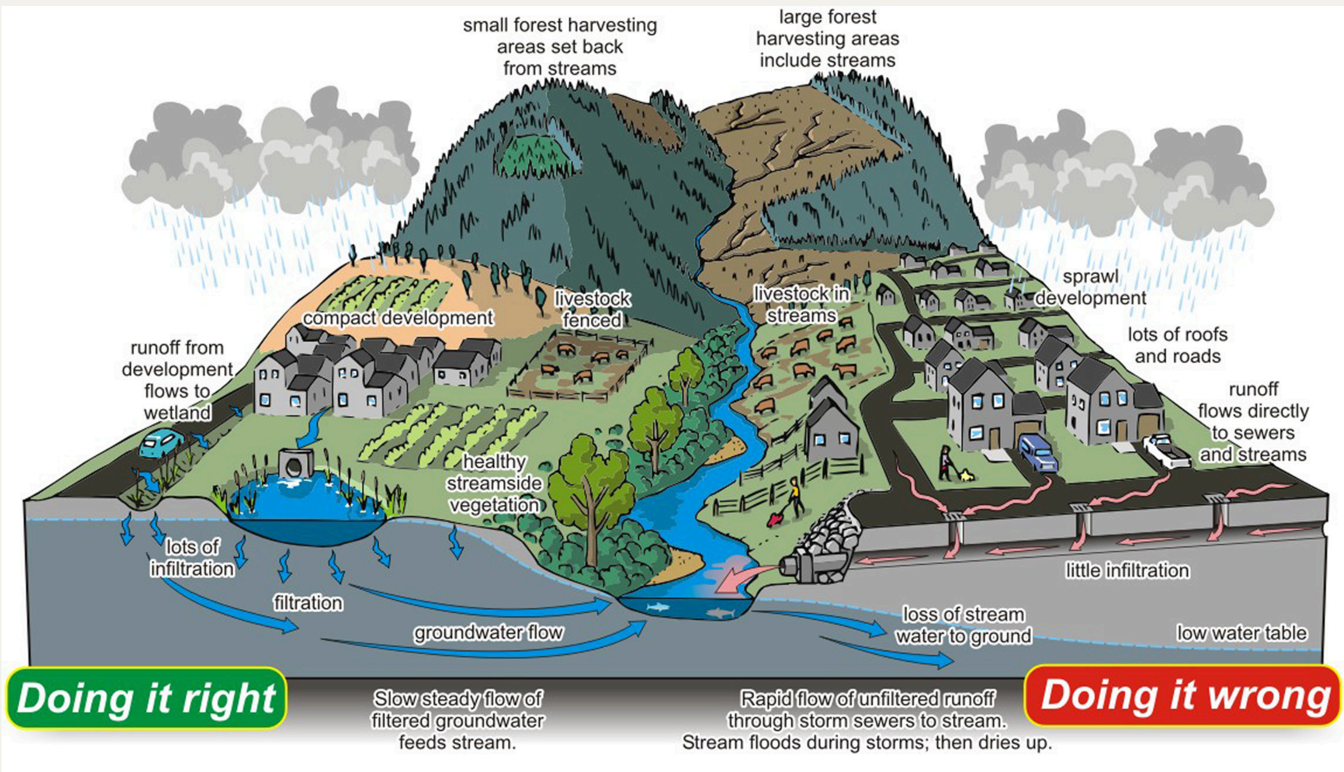
Essential Learnings

1. Okanagan ecosystems require sufficient water to be sustainable
2. Urban development and agriculture in the basin is competing for space with existing ecosystems
3. Urban and agricultural lands must be managed to maintain healthy aquatic ecosystems

We Need Healthy Streams and Groundwater

Background

Protection and conservation (Stewardship) of aquatic ecosystems is essential to sustain plant, animal and human communities into the future.



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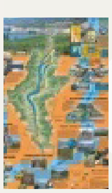
Note: the above vector diagram is available in Appendix: Maps and Illustrations.

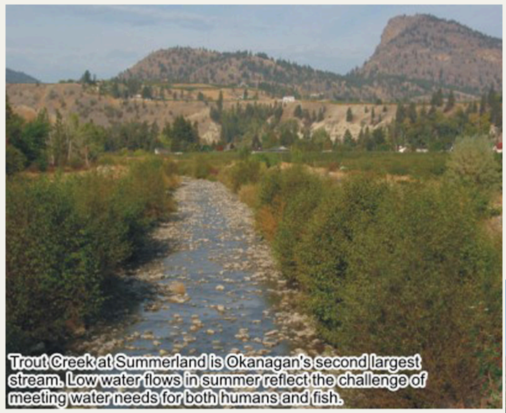


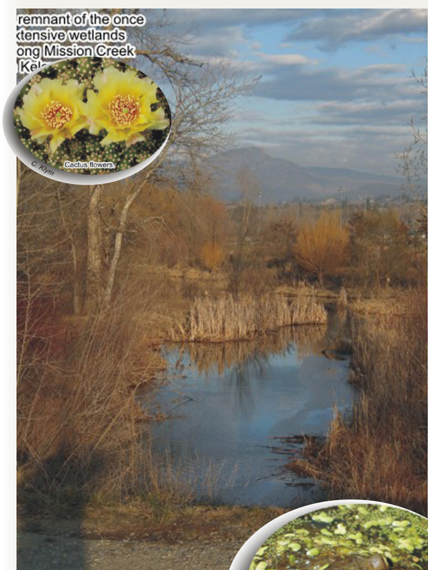
Protecting Nature's Water Needs

Background

Nature was here first

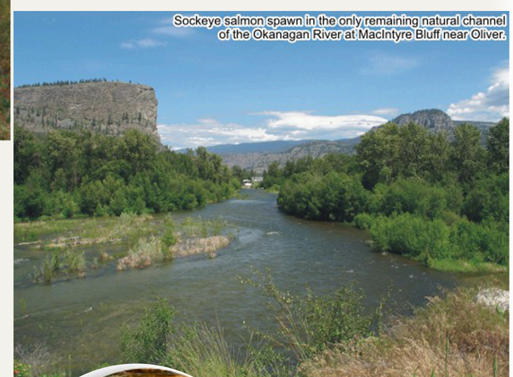
Okanagan Basin ecosystems range from highland forests to semiarid grasslands. What treasures! These plants and animals are the oldest water users in the valley and remain important and legitimate water users today. A major reason for us to conserve water is to ensure that nature has enough for its own needs.

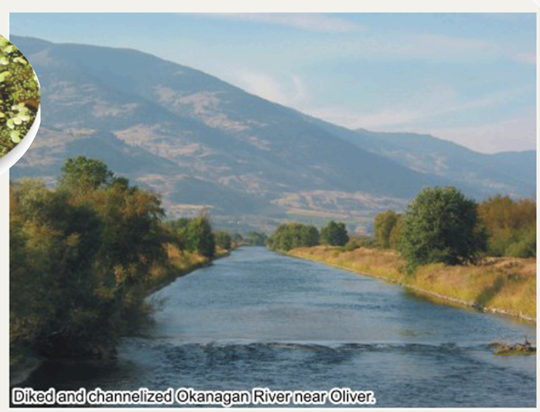

Trout Creek at Summerland is Okanagan's second largest stream. Low water flows in summer reflect the challenge of meeting water needs for both humans and fish.



Down in the valley, competition between nature and humans is fierce.

We use valley bottoms in the Okanagan Basin for agriculture, recreation, towns and roads. Nature has been squeezed out of many areas. Wetlands have been drained and filled, and many streams and rivers channelized and diked to create land for our agriculture and towns. Remaining wild spaces are precious. Loss of habitat has put many species at risk, including the peregrine falcon, yellow-breasted chat and sockeye salmon.

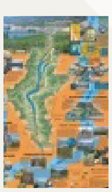

Sockeye salmon spawn in the only remaining natural channel of the Okanagan River at MacIntyre Bluff near Oliver.


Diked and channelized Okanagan River near Oliver.

Water for fish

Fish species in our lakes and streams need clean water year-around in which to live. Sockeye salmon spawn in the Okanagan River and rear in Osoyoos Lake. These salmon are one of the few remaining natural runs in the entire Columbia River system. Shorelines of Okanagan Lake and streams are critical spawning areas for kokanee.

All photos by R. Turner, for Geological Survey of Canada Miscellaneous Report 93



Activity 16 ~ Yellow Fish Road

Curriculum Connections

Grade 5: Science Processes; Earth and Space Science
Social Studies Skills and Processes
Language Arts, Personal Planning

Time

4 hours (include field trip time)

Objectives

- Students will be introduced to the Yellow Fish Storm drain marking program.
- Think! It's what you drink!
- Teach your students how they can make a difference in the Okanagan's water quality.

Materials

- Storm drain marking kit (provided by the City)
- Copy of "Follow the Yellowfish Road"

Key Vocabulary

- storm drain
- stewardship

photo: Angela Griffin

Activity 16 ~ Yellow Fish Road cont'd

ACTIVITY

1. Get your students "hooked" on what your class is about to do by distributing a copy of "Follow the Yellowfish Road" song (attached). At the end of the field trip (as a wrap up), you can get individual student groups to come up with their own version of the song based on what they have learned and experienced.

2. Invite a representative of your city's Environmental or Engineering department into your classroom (see "Additional Notes Concerning Yellow Fish Road" below). They are usually more than willing to share information about how residents can maintain a healthy watershed and the role students can take in providing information to the public.

3. Once background information has been given, students become "Yellow Fish Road" volunteers who paint "yellow fish" symbols next to storm drains (the grates next to the curb) and distribute fish-shaped brochures to nearby households. They will remind people that anything that enters the storm drain system goes directly into Lake Okanangan (in the Okanagan, storm drains connect to various streams and creeks untreated).

   Anything (like litter, salt, soap and fertilizer) that runs off lawns, driveways, sidewalks and roads can end up in the lake. These wastes can have a negative impact on the aquatic ecosystem–not only by harming fish and wildlife, but by reducing drinking water quality for humans.

4. Discuss with the Waterworks department about which area in your city would best benefit from storm drain marking. They will usually provide you with several options. Once this is decided upon, they will provide your class with the necessary equipment to mark the drains (eco-friendly paint, stencils, brushes, safety vests and gloves etc.)

5. It is usually best to divide students up into groups of two or three, each with a parent volunteer as this allows for more drains to be painted.

Guiding Questions

1. Why is important to maintain a healthy water shed?

2. What things affect a watershed? (construction, urban activities, residential activities, industries)

3. What is the difference between a healthy and an unhealthy creek?

4. How are trees important to a watershed?

5. What are examples of what can be done to help watersheds?

Extensions

1. While students are marking storm drains, have them pick up litter from the street and place into garbage bags (provide students with gloves and garbage picks).

2. Take students to local science centre (ECCO centre in Kelowna) to enroll in one of the many programs they offer on watersheds, stream health, Kokanee salmon, etc.

3. Watch simple animation with sound for kids about this activity at www.yellowfishroad.org. This site has links to more information on this topic.

Follow the Yellow Fish Road

(to the tunes of "Follow the Yellow Brick Road")

Follow the Yellow Fish Road
Follow the Yellow Fish Road
Follow, follow, follow, follow
Follow the Yellow Fish Road

We're off to mark the storm drains,
To protect the fish below.
And make you all aware of the things that
cannot go down with the flow.
Pesticides and oil and gas and things you
sprinkle on the grass,
Are all items that eventually flow…
Down the creeks and rivers they go

We're off to mark the storm drains
With yellow fish so you know!

We're off to mark the storm drains,
Our drinking water is key
Our creeks and rivers flow to the lake
With nasty things you can't see
We need you all to be aware
We need you all to think and care
So think before you dump stuff down our drains,
It doesn't just disappear with the rains…

We're off to mark the storm drains
On our roads and our lanes!

Words by Angela Griffin

Activity 17 ~ Make a Waterscope

Curriculum Connections

Grade 5: Science Processes, Earth and Space Science
Social Studies Skills and Processes
Language Arts, Personal Planning

Time

1 hour

Materials

- Knife
- Yogurt container (for each child)
- Clear plastic wrap
- Elastic band (for each child)

Joanne Beaulieu

Key Vocabulary

- waterscope
- riparian vegetation

Objectives

For students make a waterscope to help them explore shoreline habitat and determine healthy living conditions.

ACTIVITY

1. Depending on the age of the students, you may want to enlist the help of parent volunteers to help cut the bottom out of the yoghurt containers. Cut the plastic carefully so that it will not scrape faces or hands.
2. After the bottoms have all been cut out, stretch plastic wrap over the top and secure it with an elastic band.
3. Take students on a field trip to a local pond, stream, creek Okanagan Lake to examine local ecosystems in our watershed.
4. Place wrap-covered end into the water; it should be watertight. Hold it several centimeters underwater for a view. Have students spread out with partners or small groups and get them to explore. Have one student make simple notes on what they find.
5. Ask students to think about what makes a healthy shoreline. Have them sketch their own healthy shoreline ecosystem.
6. Explain to students what riparian vegetation is: the vegetation that grows on the areas of both sides of a creek or stream (trees, shrubs, grasses). Ask students to point out such vegetation. Ask: what are some ways this type of vegetation benefit the creek and aquatic life? (temperature regulation, food, protection, homes, erosion control, pollution control).

Guiding Questions

1. Why is healthy shoreline important?
2. What are some signs of a healthy shoreline? Unhealthy shoreline?
3. What are some causes of water pollution?
4. What causes shoreline erosion?

Extensions

1. Visit a local water treatment facility to let students know how their waste is treated and how it is returned to the lake in a drinkable form.
2. Visit the Mission Park Greenway. Where are some areas where humans have had a major impact on this stream? (straightening the creek, removing rocks and branches, replacing trees with grass etc).

Activity 18 ~ Stream Science

Note: This activity involves three stages, each lasting one period.

Curriculum Connections

Grade 7: Science Processes, Life Science Ecosystems
Grade 8: Earth and Space Science Water Systems

Time

2 indoor class periods, 2 outdoor classes at a nearby stream

Objectives

- Identify the diverse elements that are necessary for a healthy stream or lake.
- Create a life web to record and classify the living and non-living elements in a stream
- Conduct water testing of PH levels in streams and analyse the effects of PH levels outside the optimum range.
- Participate in a stream clean-up or riparian planting to repair a damaged stream.

Materials

- Colour overhead of Penticton Channel or other unhealthy stream
- Stethoscope
- Computer lab or student lap tops

For each group

- A set of Stream Science charts (6 pages per set)
- Pencils, markers
- Laminated macro-invertebrate identification chart
- Laminated water quality data charts
- Plant identification guide (if available)
- Measuring tape or stick
- Thermometer
- Float or bobber with fishing line

agroup materials cont'd

- Stopwatch or watch with a second hand
- Fine mesh net or kick seine net
- White sheet
- White ice cube tray
- Ladle or large spoon
- Tweezers
- Magnifying glass
- Water testing kit (PH, dissolved oxygen, nitrate)
- Towel
- Garbage bag
- Empty, clean water bottle

ACTIVITY

In the classroom, display a photo of an unhealthy stream to the students using the overhead projector. Why is this stream unhealthy? Students brainstorm and identify 'What's wrong with this stream'.

To prompt students, tell them they are going to be 'stream doctors'. As you hold a stethoscope to different sections of the stream image, have them diagnose the problem.

At the computer lab, or using lap tops if available, refer students to the 'Stream Cleaner' website, where they will identify unhealthy components of a stream and complete a stream clean-up activity.

Website: Stream Cleaner Web Game, Potomac Highlands Watershed School
http://www.cacaponinstitute.org/e_classroom.htm

Go through the Middle School door–Activities-Stream Cleaner (requires Flash). Log on as a visitor. An introduction to the concepts of the game is available at the Middle School classroom window (slide show).

Activity 18 ~ Stream Science cont'd

ACTIVITY

1. Time permitting, have students work in group to compile a list of the elements that make a healthy stream. Compile the lists into a class Stream Science chart that will be used to guide the outdoor observations and experiments at the stream. The compiled list of elements should include:

    - Water: colour, turbidity, speed, temperature, stream width, depth at stream centre, PH level, dissolved oxygen level and nitrate level.

    - Stream banks and bottom: type of rock, soil, erosion, deposition, stream meanders and backflows and agriculture, development or other sources of contamination adjacent to the stream.

    - Living elements: plant life in the stream and along the banks, vegetation and trees for shade and eddies, animal life in the stream, and evidence of wild or domestic animals using the stream.

    - Human elements in or near the stream, such as bridges, dams, pathways, or buildings.

    - Evidence of point or non-point source pollution entering the stream.

      A reproducible master set of the Stream Science charts is included for reference or for classroom use.

2. At the stream, students work in groups of 4 or 5 to complete their group's stream science chart. As they complete their observations and measurements, student should rate the overall health of each element on the scale included with the chart.

   Groups of students should be placed at different stations along the stream in order to collect a more complete picture of the stream's health.

    - Water testing may be completed back in the classroom instead of on-site–have each group collect a water sample in an empty, clean water bottle.

3. At the classroom, each group presents their stream data, rates the overall health of the stream based on their data collected and proposes a course of action to improve the stream's health.

   The actions proposed may be a whole classroom effort or individual group effort, and should include a goal and a timeline. Student action may take the form of letters to City Hall, environmental poster vegetation replanting, or a stream clean-up.

   For stream-side work such as replantings and pollution clean-ups, assistance may be available through City Hall: Environmental Education Department, or through the Regional District Offices in the Okanagan.

Activity 18 ~ Stream Science cont'd

Extensions

- The groups use their stream data and observation sheets to chart and measure the stream health along the different measurement stations. The information compiled is then used to graph the data for each indicator.
- Individually, students research and map their stream by designing and drawing a pictorial map of the stream's watershed, from source to lake.
- Students create an aquatic 'life web' or food web of the stream, including all living and non-living elements recorded.
- The class continues to re-measure the stream's health throughout the year, especially after actions to improve stream health have been completed.
- Schools may join the 'Adopt a Stream' program, taking long-term responsibility for the health of their stream.

  (City of Kelowna, Environmental Education Department)

Stream Science Safety Rules

Student Rules:

- Students should wear suitable clothing for stream work.
- Students must stay with their assigned groups.
- Students must know and comply with the defined stream boundaries – this protects both the students and the plant and animal wildlife.
- Students should not enter the stream without supervision.
- Students should not touch, taste, or damage in any way the plants and wildlife at the stream.
- Please remove any materials used in the field work, including the station flags set up previously.

Notes for the teacher

- Visit the stream first to determine if it is safe for outdoor classroom work. Check the velocity, depth, and temperature of the stream, and note any potentially dangerous animals or plants in the vicinity.
- Define stream boundaries.
- Mark and flag safe stream stations for the student groups to work at.
- Bring a first aid kit, several towels, and waterless hand sanitizer.
- Bring extra copies of Stream Science charts, or laminate each group's charts to waterproof them.
- Ensure that you have enough adults to monitor the students at each station; your local city's Environmental Education Department or Okanagan Regional District office may be able to assist with stream monitoring.

Student Worksheet 1: Stream Science Field Data

Stream ________________________________ Site number _____________

Collectors: ____

Collection Date: __________________________ Time of day: ____________________

Weather conditions (last 3 days): ____

____ Air temperature: ________ °C

Water:

Stream temperature: ___________ ∞C Water colour: ____________________

Water appearance: clear ___ cloudy___ muddy___

Water odour : ___________________________

Average width at site: ___________________________(cm/ m)

Stream depth: _________________________________(cm/m)

Water level appears to be: high ___ normal ___ low ___ dry ___

Stream-flow rate: ____________m/sec. high ___ normal ___ low ___

Stream riffles or backflows (within 10m): ____

Streambed and Banks: ____

Streambed description: ____

Stream bank material: clay__ mud__ dirt__ rocks__ stones__ mixed__

Stream bank description: ____

Sun/shade conditions: ____

____

Student Worksheet 2: Stream Science Field Data

Stream ______________________________________ Site number ________________

Collectors: ____

Collection date: ________________________________ Time of day: _______________

Weather conditions (last 3 days): ____

____ Air temperature: _______°C

Water:

Stream temperature: ____________°C Water colour: __________________________

Water appearance: __ clear __ cloudy __ muddy

Water odor : ___________________________________

Average width at site: ______________________(cm/ m)

Stream depth: ____________________________(cm/m)

Water level appears to be: __ high __ normal __ low __ dry

Stream-flow rate: ________m/sec. __ high __ normal __ low

Stream riffles or backflows (within 10m): ____

Streambed and Banks:

Streambed description: ____

Stream bank material: __ clay __ mud __ dirt __ rocks __ stones __ mixed

Stream bank description: ____

Sun / shade conditions: ____

____

Student Worksheet 3: Stream Science Field Data

Site number ______________________________ Collectors: _________________________________

Riparian Vegetation:

Types of vegetation along banks: ____

____

____

Canopy Cover: __ < 60% cover (open) __ > 60% cover (closed)

Macro-invertebrates:

Sensitive to Pollution	Somewhat Sensitive	Tolerant of Pollution
__ caddisfly larvae	__ beetle larvae	__ aquatic worms
__ hellgrammite	__ clams	__ blackfly larvae
__ mayfly larvae	__ crane fly larvae	__ leeches
__ gilled snails	__ crayfish	__ midge larvae
__ adult riffle beetle	__ damselfly larvae	__ lunged snails
__ stonefly larvae	__ dragonfly larvae	
__ water penny larvae	__ scuds	
	__ sowbugs	
	__ fishfly larvae	
	__ alderfly larvae	
	__ watersnipe larvae	
Total Count =	**Total Count =**	**Total Count =**
Boxes checked x 3 = Index Value	Boxes checked x 3 =Index Value	Boxes checked x 3 = Index Value
Index Value =	**Index Value =**	**Index Value =**

Water Quality Rating based on macro-invertebrate count:

Total Index Value = ___________________________

__ excellent (>22) __ good (17-22) __ fair (11-16) __ poor (<11)

Student Worksheet 4: Stream Science Field Data

Site number ________________ Collectors: ____

Stream Health Rating:

Overall the stream is: ____

____

____

Based on: ____

____

____

____

Recommended Actions: ____

____

____

____

____

Using Macro-invertebrates to Determine Water Quality

Macro-invertebrates (water 'bugs' such as insect larvae, snails, aquatic worms and leeches) are excellent indicators of water quality, as they live much of their life cycle in the same area of a stream or lake. Aquatic macro-invertebrates include mainly larval forms of both common and uncommon insects. Commonly seen insect larvae include dragon flies and damselflies. Less common insects include stoneflies, mayflies, alderflies, midge fly and blackfly larvae. Non-insect indicators include snails, crawfish, sowbugs, clams, aquatic worms and leeches. These macro-invertebrates and small stream animals can be identified using the following picture guide. The guide also shows which water quality group each organism falls in. Water quality groups include:

1) Sensitive to pollution: presence of these macro-invertebrates in a stream indicate stream health
2) Somewhat sensitive to pollution: their presence points towards reasonable stream health
3) Pollution tolerant: if a stream contains only these pollution-tolerant macro-invertebrates, the stream is likely polluted and unhealthy

A total count of all macro-invertebrates found in the stream sample should be taken–greater numbers indicate a healthier stream, as does a wide assortment of all types of macro-invertebrates.

Student Worksheet 5: Macro-Invertebrate Identification: Common Types

Macroinvertebrates that are sensitive to pollution (found in good quality water):

Macroinvertebrates That Are Tolerant of Pollution (found in any quality water):

Temperature Ranges (Approximate) Required for Certain Organisms

Temperature	Examples of Life
Greater than 20 degrees C (warm water)	Much plant life, bass, crappie, bluegill, carp, catfish, leaches, caddisfly
Middle range (12-20 degrees C)	Some plant life, trout, stonefly, mayfly, caddisfly, water beetle
Low range Less than 12 degrees C	Trout, caddisfly, stonefly, mayfly

Student Worksheet 6: Water Quality Data Tables

PH Ranges that Support Aquatic Life

	Most Acid -- Neutral -- Most Alkaline 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Bacteria:	1 - 12.0
Plants (algae, rooted, etc.):	6.5 - 12.0
Carp, suckers, catfish, some insects:	6.0 - 9.0
Bass, crappie:	6.5 - 8.5
Snails, clams, mussels:	7.0 - 9.0
Largest variety of animals (trout, mayfly, stonefly, caddisfly):	6.5 - 7.5

Dissolved Oxygen (DO) and Typical Aquatic Life Found

D.O. in parts per million (ppm) or Milligrams per liter	Typical Aquatic Life Found	Typical Water Temperature
8 ppm and up	Trout; many caddisfly and mayfly, some stonefly	Below 20 degrees C
6 ppm	Bass, crappie, stonefly, midges, mosquitoes	Above 20 degrees C
4 ppm	Much algae and plant life, mosquitoes, leaches, midges	Any

Nitrate Ranges that Support Aquatic Life

<1.0 ppm	Excellent	Largest variety of animals (trout, mayfly, stonefly, caddisfly)
1.0-3.0 ppm	Good	Snails, clams, mussels, alderfly
3.1-5.0 ppm	Fair	Much plant life, midge fly, aquatic worms, leaches, mosquitoes
>5.0 ppm	Poor	Bacteria, algae

Activity 18 ~ Stream Science cont'd

Collecting Macro-invertebrates: Notes for teachers

Positioning the kick seine or netting

Have one person hold the net or kick seine upright facing the stream flow downstream edge of the sampling area. The net should be stretched out to its full width with the bottom edge lying firmly against the stream bed. No water should wash under or over the net. If needed, small rocks can be used to weigh down the bottom edge of the net.

NOTE: To avoid losing macro-invertebrates, do not stand in or disturb the sampling area before the kick seine is in place.

Collecting the samples

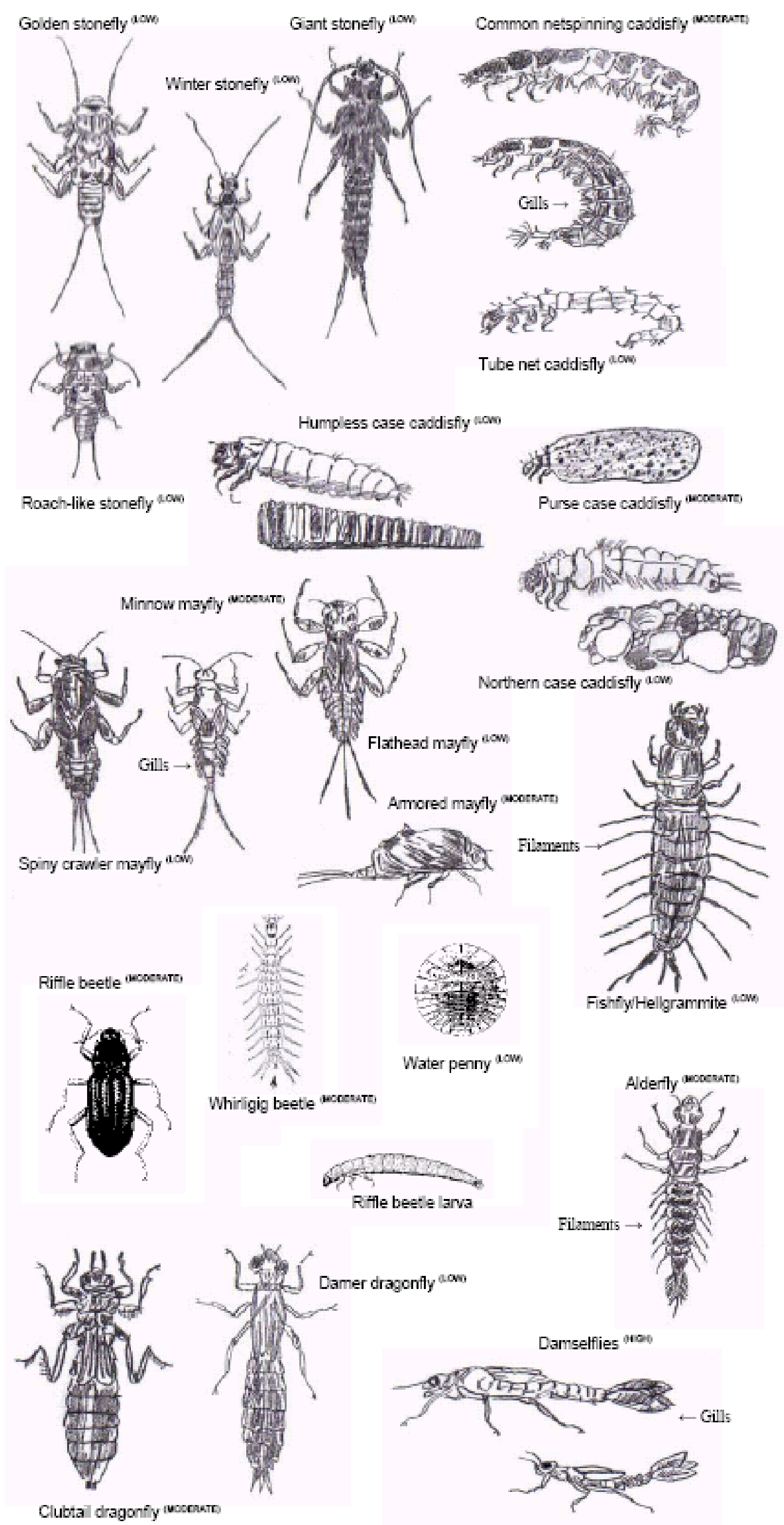
All macro-invertebrates in the sample area are to be washed into the kick seine. While one person holds the net, a second person first brushes all the larger stones in the sampling area to dislodge the attached macro-invertebrates. As each stone is brushed, it can be placed outside the sampling area. When all the stones are brushed, stir up the entire sampling area with hands and feet to dislodge any burrowing macro-invertebrates. Finally, for at least sixty seconds, kick the stream bed with a sideways shuffling motion towards the net. The object is to thoroughly work up the stream bed to a depth of several inches.

Removing the kick seine from the water

Lift the kick seine out of the water with a forward scooping motion. The object is to avoid losing any macro-invertebrate specimens while the seine is lifted. This will be easier if one person holds the top of the kick seine handles while the other person holds the bottom of the handles.

Removing the samples from the kick seine

Carry the kick seine to the stream bank and spread it out flat. Carefully examine the net and the collected debris for macro-invertebrates. Look carefully as many specimens will be small and hard to see. Using tweezers or fingers, place all the specimens in sections of the ice cube tray filled with stream water. Sort them into different types as you remove them from the net, and place each type in a separate section.



A GUIDE TO AQUATIC MACROINVERTEBRATES

Insect Groups

Stoneflies (order ***Plecoptera***): Three pairs of legs (6); 2 hooked claws at the end of each leg; no gills on the abdomen but many gills on the legs and thorax; 2 tails and 2 very long antennae.

Mayflies (order ***Ephemeroptera***): Three pairs of legs (6); one hooked claw at the end of each leg; gills on the abdomen (may be covered by plates); 2 or 3 tails and 2 short antennae.

Caddisflies (order ***Trichoptera***): Three pairs of legs (6); segmented grub-like body; may have gills along lower and upper portions of the abdomen; small hair-like tails or hooks. Some kinds may be enclosed in a case that they construct using stream bottom materials such as pebbles, sand grains, woody debris, pieces of plant material or some combination; others construct nets, and others do neither (free-living caddisfly). The case builders often construct a specific case that can sometimes be used in their identification. The common netspinning caddisfly (family ***Hydropsychidae***) is more tolerant than most of the group. They can be distinguished from other caddisflies by the abundant gills on the underside of their body, their obvious filamentous tails and their very particular swimming "dancing" motion.

Beetles (order ***Coleoptera***): Three pairs of legs (6); mainly rounded or oval shape as adults; a few kinds have tails hooks or filaments, hard bodies and visible wing-pads. The most commonly encountered beetles are the riffle beetle (family ***Elmidae***), which is a small dark beetle and water penny (family ***Psephenidae***), which looks like a penny. The whirligig beetle larva (family ***Gyrinidae***) may have many filaments along their bodies similar to fishflies.

Fishflies, Hellgrammites and Alderflies (order ***Megaloptera***): Three pairs of legs (6); filaments along the body starting just below the legs; variable tails at the end of the abdomen. Alderflies (family ***Sialidae***) have a long tapered tail; the fishfly has double hooked-tail (family ***Corydalidae***). The hellgrammites (family ***Corydalidae***) have gill-tufts under each of their filaments while fishflies and alderflies do not. All members of the group have large pinching jaws on the head.

Damselflies (sub order ***Zygoptera***): Three pairs of legs (6); long, thin abdomen; large eyes; extended lower lip; 3 fan like structures, which are actually their gills, at the end of the abdomen.

Dragonflies (sub order ***Anisoptera***): Three pairs of legs (6); extended lower lip; large eyes; rounded or extended abdomen; no gills on the abdomen; no tails but may have knobs or points on the abdomen that resemble tails.

Be aware that multiple families are often collected and not all are shown here.

Aquatic macroinvertebrates are excellent indicators of stream conditions. These macroinvertebrate communities exist in almost all types of aquatic environments and their abundance, composition and diversity are clues to a wide variety of past and present environmental disturbances (stress). Visit West Virginia Save Our Streams on the Internet at: http://www.wvdep.org/dwwm/wvsos for more information.

Student Worksheet 7: Stream Science Field Data

Site number ____________________ Collectors: ____

Pollution Sources:

List any visible pollution sources or evidence of pollution with 100 metres of your stream site:

____

____

____

____

____

Human Elements:

List any man-made structures, including pavement, within 100 metres of your stream site:

____

____

____

____

____

____