Skein 4

Water Cycle

Watershed

Overview:
This skein gives students the opportunity to:

- **I** Discuss what the water cycle is.
- **I** Observe water cycling in a glass container.
- **I** Construct and discuss a model of a water shed.
- **I** Begin to construct a watershed wall mural or display linked to the stages of the salmon's life cycle.

Big Ideas:

- The water cycle, the watershed, and ocean conditions form the broad context in which salmon ecology and human ecology take place.
- Each stage of the salmon's life cycle relies on parts of the aquatic ecosystem in which they live.

Vocabulary:

water cycle, hydrologic cycle, life cycle, habitat, watershed, transpiration, evaporation, ecology, atmosphere, deforestation, runoff, lake, pond, stream, creek, river, solar energy

Important Standards Netted by Teaching Skein 4

SCIENCE

	Fourth Grade	Fifth Grade	Sixth Grade
Classroom Incubation of Eggs	SA 1.1	SA 1.1	SA 1.1
	SA 1.2	SA 1.2	SA 3.1
	SA 3.1	SA 3.1	SD 1.3
	SB 1.1	SB 1.1	SB 3.1
	SB 3.1	SB 3.2	
	SD 1.2	SD 2.1	
	SD 2.1	SE 1.1	
	SE 3.1	SE 3.1	

READING

Water Cycle	R 1.6	R 2.6	
	R 1.5	R 2.5	
	R 1.4	R 2.4	
Runoff Pollution	R 1.1	R 21.1	
	R 3.1	R 4.1	
	R 1.2	R 2.2	

WRITING	**Fourth Grade**	**Fifth Grade**	**Sixth Grade**
	W 2.1.2	W 2.1.3	W 2.1.3
	W 2.2.2	W 2.2.2	W 2.2.2
			W 2.2.4

BACKGROUND INFORMATION

WATER CYCLE

The information below supplements the information in Handout 4.2, "The Water Cycle and the Watershed," (Parts 1 & 2), and Handout 4.3, "An Overview of the Salmon Life Cycle," (Parts 1 & 2).

WATER STEWARDSHIP

All living things need water. People need about 80 liters a day for domestic, agricultural and industrial uses (although North Americans use an average of 500 liters a day).

British Columbia, the Yukon, and Alaska contain some of the world's richest aquatic systems, with thousands of kilometers (km; or miles) of coastline and some of the biggest rivers and watersheds in the world. Many areas on the Pacific Coast receive over 1,000 millimeters (approximately 40 inches) of precipitation every year. The interior regions receive enough rainfall for extensive forests and grasslands to thrive, and most of the southern drylands can be irrigated by large lake and river systems.

These waterways are habitats for a great diversity of plants and animals, including Pacific salmon which migrate, sometimes thousands of kilometers (km; or miles), from small, clear lakes and streams to the ocean and then back again. To understand the life of the Pacific salmon, students need to start with the salmon's aquatic habitat.

Understanding water systems involves several key concepts (Adapted from McLaren et al., Water Stewardship, pages 19 to 21):

- Water is essential for life and all living things depend on water.
- All water is part of the hydrologic or water cycle.
- Streams, lakes, rivers, and other water bodies are part of larger systems known as watersheds.
- Watersheds are dynamic; they change over time as a result of geological and biological processes, as well as human activities.
- Humans are major users of water.
- Although part of an ongoing cycle, water is finite, and clean water is very limited.
- Aquatic habitats are essential elements of the biosphere.
- Contaminants and toxins can move within water and can have harmful effects on life.
- Different human cultures have different values about water and different patterns of use.
- Human activities that are harmful to water supplies and aquatic environments can be reduced. People can practice water stewardship to protect water resources for the future.

When students learn how their own activities, and the activities of their communities, affect the aquatic habitat of salmon and other species, they can begin to practice water stewardship in their own lives.

The Water Cycle [demonstration]

Materials:

- One heat-proof glass container containing approximately one liter of water (The container should have a small opening, but should not close completely.)
- One heat source for a demonstration
- One copy of Handout 4.1, "Water Cycle Procedure," for each student
- One copy of Handout 4.2, "The Water Cycle and Watersheds," (Parts 1 & 2), for each student
- Writing supplies

Time Required:
Approximately 60 minutes in two periods

Level of Conceptual Difficulty:
Moderate

LESSON

- Give students a copy of Handout 4.1, "Water Cycle Procedure," and have them complete the steps listed. Alternatively, lead the class in a demonstration of the activity.

DISCUSSION

- Use the board to diagram the activity in the form of a cycle. Have students identify what drives and what limits the cycling.
  The energy from the heat source drives the cycle. The container walls and the cool outside air limit it by condensing the vapor, which precipitates completing the cycle.

- Have students use their own knowledge or Handout 4.2, "The Water Cycle and Watersheds," (Parts 1 & 2), to compare the water cycle in the activity with the atmospheric water cycle. If necessary, prompt them with questions, such as:

  - Where do we see water that is part of the atmospheric water cycle?
    In the form of rain, snow, lakes, ponds, streams, oceans, etc.
  - What is the energy source that drives the atmospheric water cycle?
    Solar energy, i.e., the sun.
  - What causes water vapor to condense and fall back to earth?
    Cool upper elevation atmosphere.
  - How does condensed water return to the oceans?
    Through precipitation falling on the ocean, or falling on land and flowing through streams and rivers or underground to the sea.
  - How long will the water continue to cycle through the oceans and the sky?
    Forever, or at least as long as the water and the sun exist.

- Have students describe what would happen to the water cycle in the container if the cycle were disrupted. If necessary, prompt them with questions, such as:

Evidence for Assessment:
Review the students' written observations and conclusions to ensure that the students can trace the cycling of water in the container. Monitor their discussion and atmospheric diagrams to ensure that they can trace the cycling of water in the environment and identify potential human impacts.

- What would happen if the heat source were hotter?
  The water would boil and it might destroy the container.
- What would happen if the heat source were removed?
  The water would not evaporate and the cycle would end.
- What would happen if the container were open?
  The vapor would escape, the water would dry up and the cycle would end.
- How are interruptions to the water cycle in the container similar to or different from interruptions to the water cycle on earth?
  The water and energy on earth are not likely to end, but small changes could still have major effects.

☞ Have students describe what might happen if the water cycle on earth were disrupted. If necessary, prompt them with questions, such as:

- If atmospheric change were to increase the solar energy that drives the water cycle, what might happen?
  The atmosphere might get warmer and more humid, possibly causing storms and changing climate and weather patterns. This is similar to global warming, in which the sun's energy builds up in the earth's atmosphere and the climate becomes warmer.
- If atmospheric change were to decrease the solar energy that drives the water cycle, what might happen?
  The atmosphere and ocean might get cooler, possibly changing the climate and weather patterns responsible for plant and animal growth.
- If atmospheric pollution were to contaminate moisture in the air, what might happen?
  Pollution might reduce the solar energy that drives the water cycle and change climate patterns, or it might dissolve in the water that falls as precipitation and pollute land and water.

SUMMATION

☞ Have students create parallel diagrams, comparing the cycling of water in the container with the cycling of water in the environment. Have them describe the cycle in a paragraph.

☞ Option: Have students use maps of the local area (lakes, stream, mountains, etc.) to diagram local aspects of the water cycle, including sources of atmospheric moisture, locations where it falls to earth, and ways in which it returns to the sea.

Water Cycle Procedure

Handout 4.1

Name _____

Hypothesis

When water is heated in a closed container, what is going to happen?

_____

_____

_____

Teacher Demonstration

1. Place approximately one liter of water in a large heat-proof glass container. Place a top on the container loosely enough to allow any steam that forms to escape.
2. Place the container over a heat source. USE CAUTION AROUND HEAT SOURCES.

Student Observation

3. Describe any changes that you see in the glass container:

_____

_____

_____

_____

Teacher Demonstration

4. When vapor begins to form, reduce heat while maintaining the water vapor production.

Student Observation

5. Describe what happens to the vapor inside the container.
   (Where does it come from? Where does it go?)

_____

_____

_____

_____

Conclusion

6. What do your observations tell you about the hypothesis?

_____

_____

_____

The Water Cycle And The Watershed

Handout 4.2, (Part 1)

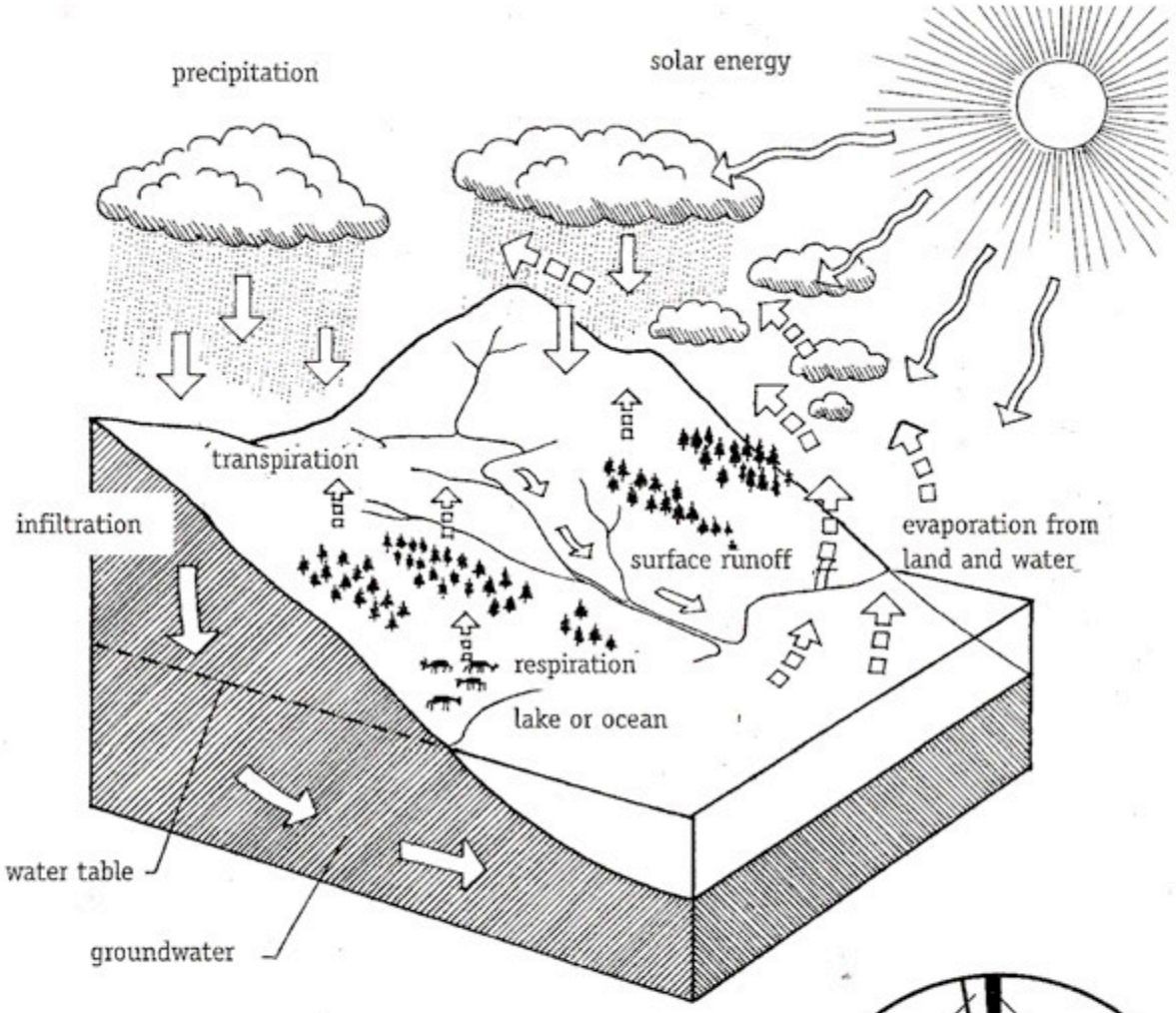
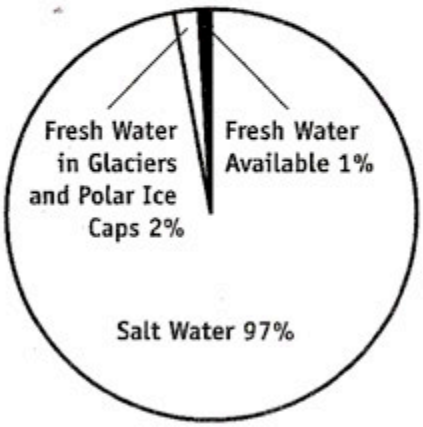


Illustration: Donald Gunn

Water covers 72 per cent of the earth's surface. Only three per cent of this is fresh water; the rest is salt water. Two-thirds of the fresh water is frozen in glaciers and the polar ice caps.



Earth's Water supply

The Water Cycle And The Watershed

Handout 4.2, (Part 2)

The water is constantly in motion. The water cycle, or hydrologic cycle, transports water from water bodies into the atmosphere and back again.

Energy from the sun, or solar energy, powers the cycle. It:

- evaporates water from the seas, fresh water lakes, rivers and streams, and the surface of the soil
- gives plants energy to take up moisture and give off water vapor from their leaves in a process called transpiration
- creates wind, which blows vapor through the atmosphere until cool air causes the vapor to condense

Water in the atmosphere falls to the ground as rain, snow, or other forms of precipitation. The moisture in the atmosphere falls to earth every 9 to 12 days, and it is replaced just as quickly.

When rain falls on land, it flows through streams and rivers until it rejoins the sea. Some water trickles into the soil, forming part of an underground, or groundwater, water system.

An area that drains into one river or stream is known as a watershed. The land, plants, and animals form part of the watershed. The watershed is where plants and animals live. Animals, like salmon, rely on a watershed to meet their needs. Animals also affect how water moves back into the atmosphere and to the sea. Plant roots can draw water out of the soil, creating pockets where water gathers temporarily. The roots can slow or stop erosion by slowing water as it moves in the soil. Beavers build dams that divert the water, and microorganisms can slowly break down rocks in the water.

The water cycle renews and cleans the water flowing in watersheds. Humans rely on water from local watersheds for drinking water, for cleaning, for recreation, and for industry. But our actions can divert, dry up, or even poison local watersheds. When we cover even part of a watershed with concrete or asphalt (like parking lots), it can change the water flow, sometimes even causing floods.

A Watershed Mural or Display

Materials:

- ✏ Copies of Handout 4.3, "An Overview of the Salmon Life Cycle," (Parts 1 & 2), for each student
- ✏ Art supplies

Time Required:

Two 40-minute lessons, plus ongoing time in future lessons

Level of Conceptual Difficulty:

Simple

Evidence for Assessment:

Review the students' displays and monitor class discussions to ensure that the students can describe environmental and human factors that influence the watershed.

INTRODUCTION

- ☞ Point out that cycles are one of the important themes in science, and ask students to identify a number of cycles they have studied (e.g., the water cycle, the nitrogen cycle, the carbon cycle, plant and animal life cycles).

DISCUSSION

- ☞ Have students identify activities in their own or their family's lives that illustrate one phase of a cycle.

- ☞ Point out that all living things go through a cycle of growing up, growing old, having offspring and dying, and the life cycle of the salmon will be one illustration of that cycle.

SUMMATION

- ☞ Have students review the life cycle of a salmon from previous knowledge or from Handout 4.3, "An Overview of the Salmon Life Cycle," (Parts 1 & 2), and predict where salmon live in the watershed at each stage of the salmon's life cycle.

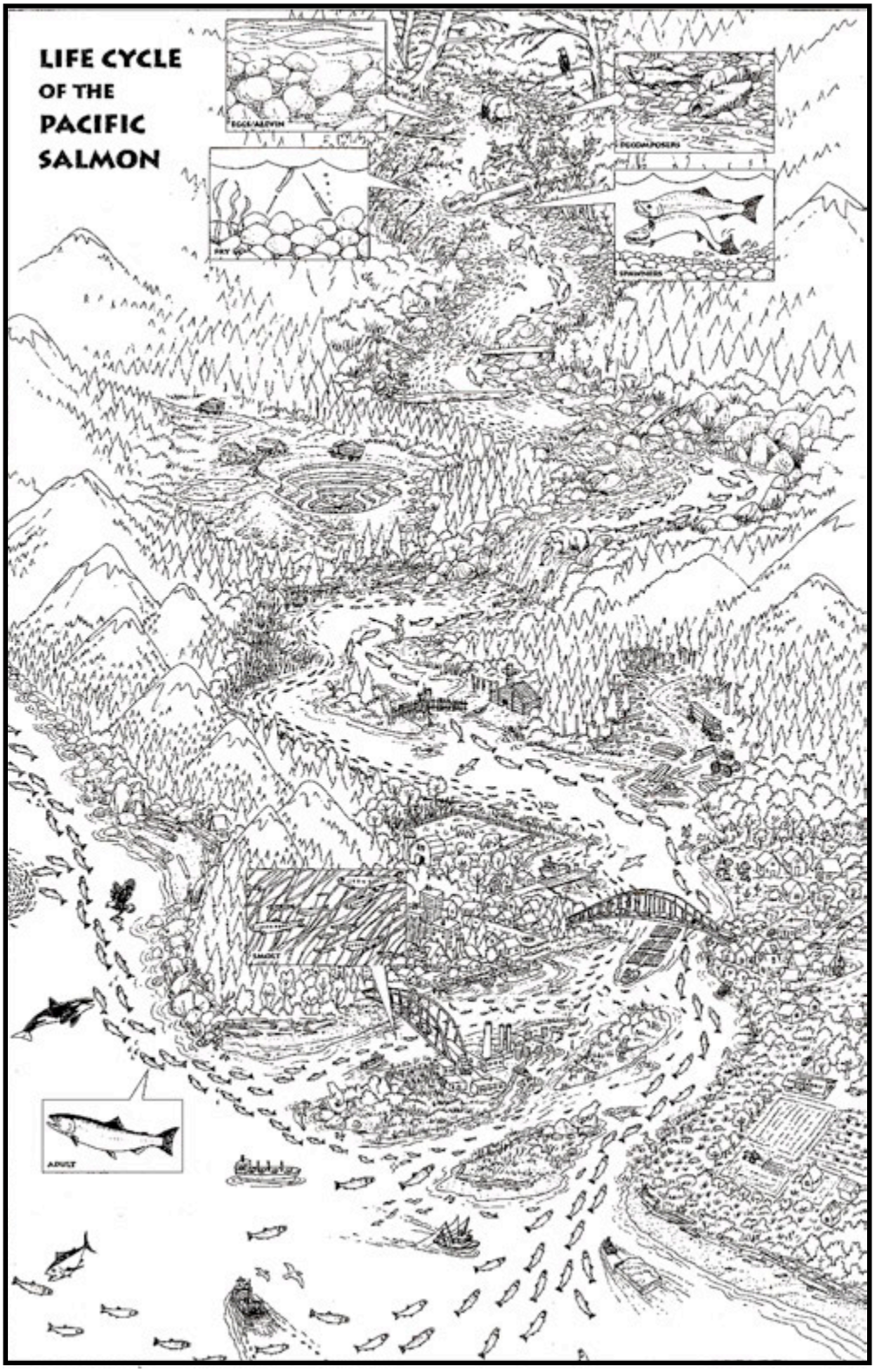
- ☞ Have the class create a large poster or bulletin board display to which they can refer and add in the following skeins. Have them show small streams draining into larger ones, then into a river, an estuary and the ocean, leaving enough space at each area to show life cycle stages of a salmon.

- ☞ In future lessons, have the class look for information they can add to the display to make a mural showing the complete life cycle of the salmon and the habitat at each stage.

An Overview Of The Salmon Cycle

Handout 4.3, (Part 1)

Illustration: Robert Browne



An Overview Of The Salmon Cycle

Handout 4.3, (Part 2)

Salmon begin their life in freshwater streams, rivers, and lakes. Their life begins in the gravel of streams or lakebeds. Mature females dig a nest, called a redd, in the gravel. Here, they lay as many as 6,000 eggs. The average is between 2,500 and 3,000. The male salmon fertilizes the eggs, and the female covers them with gravel for protection.

The eggs slowly develop under the gravel over the winter months. When the eggs hatch they are called alevin. Alevin continue to live in the gravel and take nourishment from a yolk sac attached to the underside of their bodies. By the spring, they finish the yolk sac, and miniature salmon called fry come out from the gravel.

Coho, chinook, and sockeye salmon remain in fresh water for a time. Chum and pink salmon travel downstream to the sea soon after they come out from the gravel.

Salmon fry eat constantly and grow quickly. When they reach what is called the smolt stage, they move downstream to the estuary, where the river meets the sea. They stay in the estuary for a time while their bodies adapt to being in salt water. Once the smolt can survive easily in salt water, they travel into the ocean.

Some types of salmon wander as far as 3,200 kilometers (approximately 2,000 miles) from their natal stream. Others stay closer to home. As they grow to adulthood, the salmon eat small fish and tiny animals that live in the sea.

When they are ready to spawn, or lay their eggs, the salmon return to the stream or lake where they hatched. During the difficult journey to the spawning grounds, their bodies change color and shape. Once they lay and fertilize their eggs, their life cycle is complete and the salmon die.

Runoff Pollution

Materials:

- One copy of Handout 4.4, "Runoff Pollution," (Parts 1 & 2), for each student
- Writing supplies

Time Required:

Approximately 60 minutes in two periods

Level of Conceptual Difficulty:

Moderate

Evidence for Assessment:

Monitor class discussion

DISCUSSION

- Have students read Handout 4.4, "Runoff Pollution," (Parts 1 & 2), and discuss. If necessary, prompt them with questions, such as:

  - How did the runoff water sample differ from the pond water?
    More or less silt, smell of water, oil on the surface, etc.
  - Which sample had a greater number of organisms? Which had a greater variety?
  - In which sample would salmon fry or other aquatic organisms prefer to live? Why?
    Ponds and streams have greater numbers and varieties of plant and animal life that fry can use for food and shelter. In addition, the supply and quality of water is more reliable and less polluted.
  - Where does the runoff water go?
    It soaks into nearby soil and flows into creeks, streams and drains, which sometimes flow into rivers, streams or seas.
  - What problems might be caused by runoff water from paved land?
    Instead of percolating into the ground, it tends to flow quickly, often flooding ditches and creeks with contaminated rainwater.
  - How does human development, especially in cities, affect aquatic life and the aquatic environment?
    It reduces the space for natural water, creates floods of polluted runoff, and reduces the variety and number of organisms.
  - What steps might people take to reduce the impact of urban runoff?
    Reduce the need for roads, reduce car pollution, reduce runoff floods by building porous pavement that allows water to percolate into the soil, surround pavement with natural vegetation to absorb runoff, divert polluted water into ponds or wetlands where it can be treated, etc.

- Option: Have students build small-scale models demonstrating how urban runoff water can be diverted or treated to reduce its impact.

Runoff Pollution

Handout 4.4, (Part 1)

Water pollution comes from many sources. Transportation, farms, forest activities, and boating activities can leave waste in the water that is used by salmon.

People have changed their activities to reduce pollution, but some kinds of pollution are hard to stop. Runoff is an example.

In nature, when rain falls, most trickles into the soil and gradually moves toward lakes and streams. However, cities and buildings change that flow. Roads, sidewalks, and parking lots do not absorb rainwater, nor can rain soak easily into hard-packed soil. Instead, rainwater flows across the surface to drains or puddles.

As rain flows across the surface, it can pick up dirt, chemicals and microorganisms that are harmful to salmon. Harmful pollutants include:

- oil that drips from cars onto the street;
- air pollutants that settle on the ground;
- fertilizers and herbicides sprayed near the street;
- dirt kicked from a playground;
- paints and cleaners used on a parking lot; and
- waste that people dump onto the street.

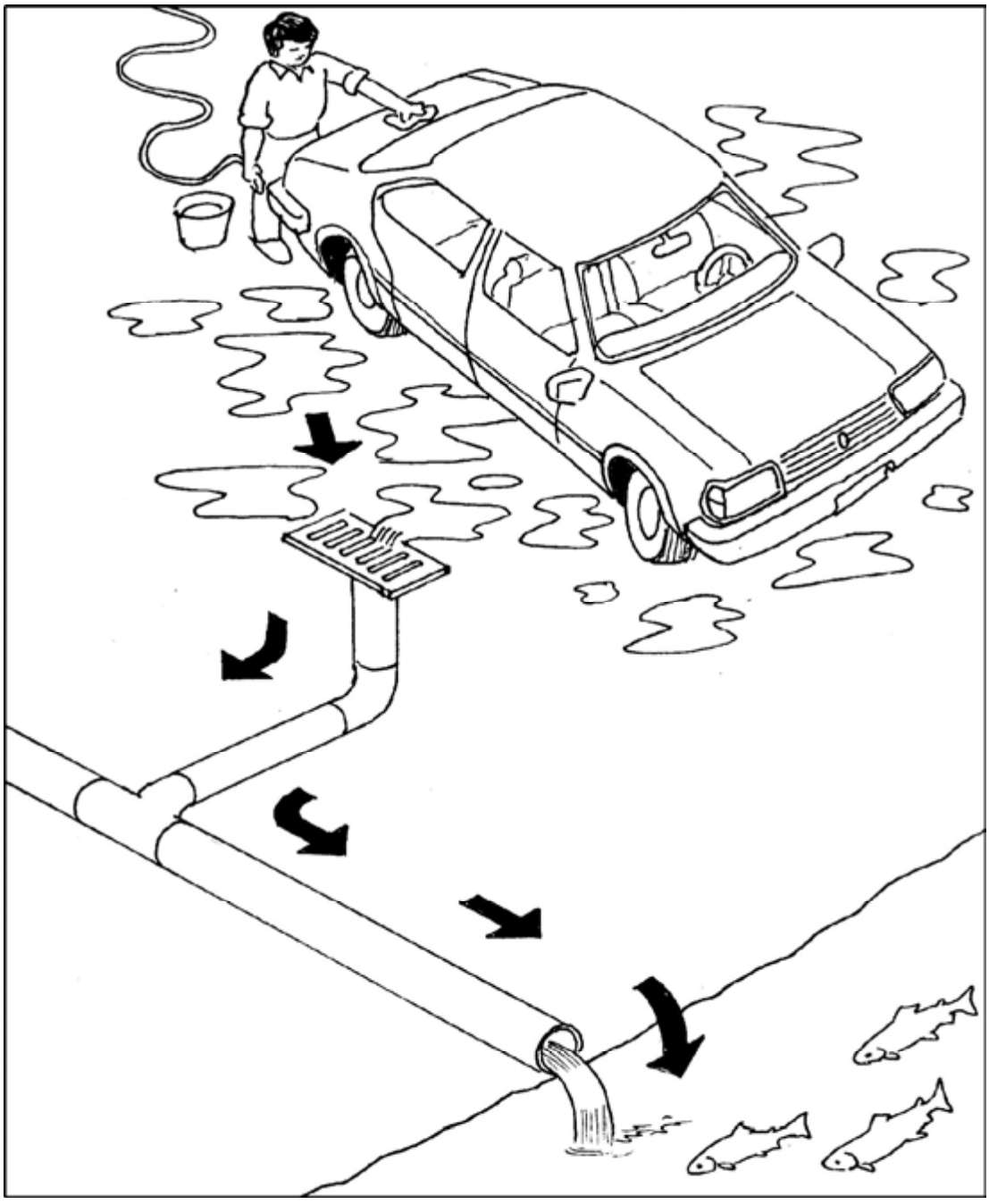
When rain carries these pollutants into a drain, it often flows to nearby streams. The pollutants then flood into a water body, where they can harm salmon and other organisms. The dirt can harm their delicate gills. The chemicals can be poisonous. Chemicals also kill insects and microorganisms that salmon need for food.

However, people can make a difference. Many schools mark road drains to remind people that waste in the drain can harm nearby streams. Some people are planting vegetation to support loose soil that will absorb rainwater. New types of pavement allow water to drain through the surface into the soil below.

Runoff Pollution

Handout 4.4, (Part 2)

Illustration: Donald Gunn



SALMON LIFE CYCLE

WRAP-UP

EXTENSION ACTIVITIES

- ☞ Have students view a video on a watershed and discuss how it relates to the life cycle stages of a salmon.

- ☞ In the schoolyard or on a nearby property, create a "natural" watershed that is exposed to the weather.

- ☞ Have students create a public announcement using posters, video, hypertext or other media to inform others of the importance of protecting watersheds.

- ☞ Have students take a field trip to a local stream and identify physical and biological factors in the local environment that form part of a watershed. Have them use the on-site studies guide in Skein Five: Salmon Habitat: On-Site Studies to examine and record features of the watershed that relate to the water cycle and the salmon life cycle.

- ☞ During the activities, have students gather information about ways in which different users use a watershed, e.g., fish, animals, a forest company, a utility company, a farmer, recreationists. Have students prepare for a city council meeting in which the different users debate, from their perspectives, for balanced use of the watershed.

- ☞ Contact your local water supplier (usually a municipal or regional government) and invite a representative to talk to your class about the water supply in your community.

- ☞ To demonstrate the slow and not so noticeable processes of evaporation, condensation, precipitation and climate change, have your students build a biosphere model.

- ☞ Have students prepare a map showing the path water takes from a source to their home, including any purification or contamination sites along the route.

SUGGESTIONS FOR ASSESSMENT

- ☞ Have students place pictures of the salmon life cycle stages in the correct order and position on a watershed diagram, then write an explanation of how each stage relates to the water cycle in a watershed.

- ☞ Monitor student discussions of the life cycle handout and mural to ensure that the students can identify the stages of the salmon's life cycle.

- ☞ Have students write quiz questions about salmon and the water cycle on one side of an index card and answers on the other. Have them quiz each other by asking the questions or using a Jeopardy-style format by giving the answers and asking for a question.

- ☞ Have students add their notes, observations, and other materials to a salmon science notebook.

SALMON LIFE CYCLE

WRAP-UP

HOME AND COMMUNITY CONNECTIONS

- ☞ Have students ask an adult to help them identify the source of the water they use in their home, the means by which it arrives at their home, and the destination of waste water and storm water runoff.
- ☞ Have students paint road drains with a salmon stencil as a reminder that waste in drains can harm streams.
- ☞ Suggest that the class begin a project to identify and protect any streams, drainage ditches, or storm drains that carry rainwater from built-up areas in the community to waterways inhabited by fish and other aquatic life.

SALMON INCUBATOR

If you have a classroom salmon egg incubator, have students learn the names of its components, examine how it works, and set it up for receiving salmon eggs.

- ☞ Have students create a chart (such as the one below) comparing the parts of the incubator and the functions they fill with the way the functions are filled in nature.

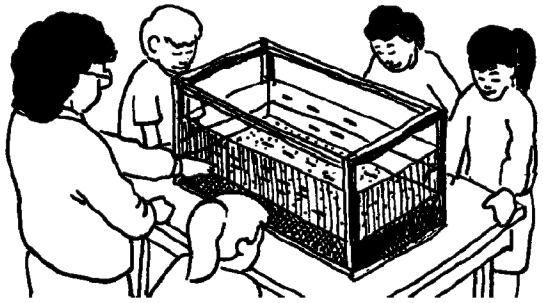


Illustration: Donald Gunn

In the tank	In nature
• Water supply provides fresh water	• Water sources (lakes, streams, rain, etc.)
• Pump/hose keeps water circulating	• Water moved downstream by gravity
• Riser tubes oxygenate and circulate water	• Riffles oxygenate moving water
• Foam cover provides darkness, and keeps water cool	• Darkness comes from gravel cover
• Dechlorinator removes chlorine	• Water does not contain chlorine
• Gravel filter changes ammonia to nitrates	• Microorganisms in water convert ammonia
• Gravel cleaner removes food and waste	• Water organisms eat and convert wastes
	• Water is chilled by cold atmosphere