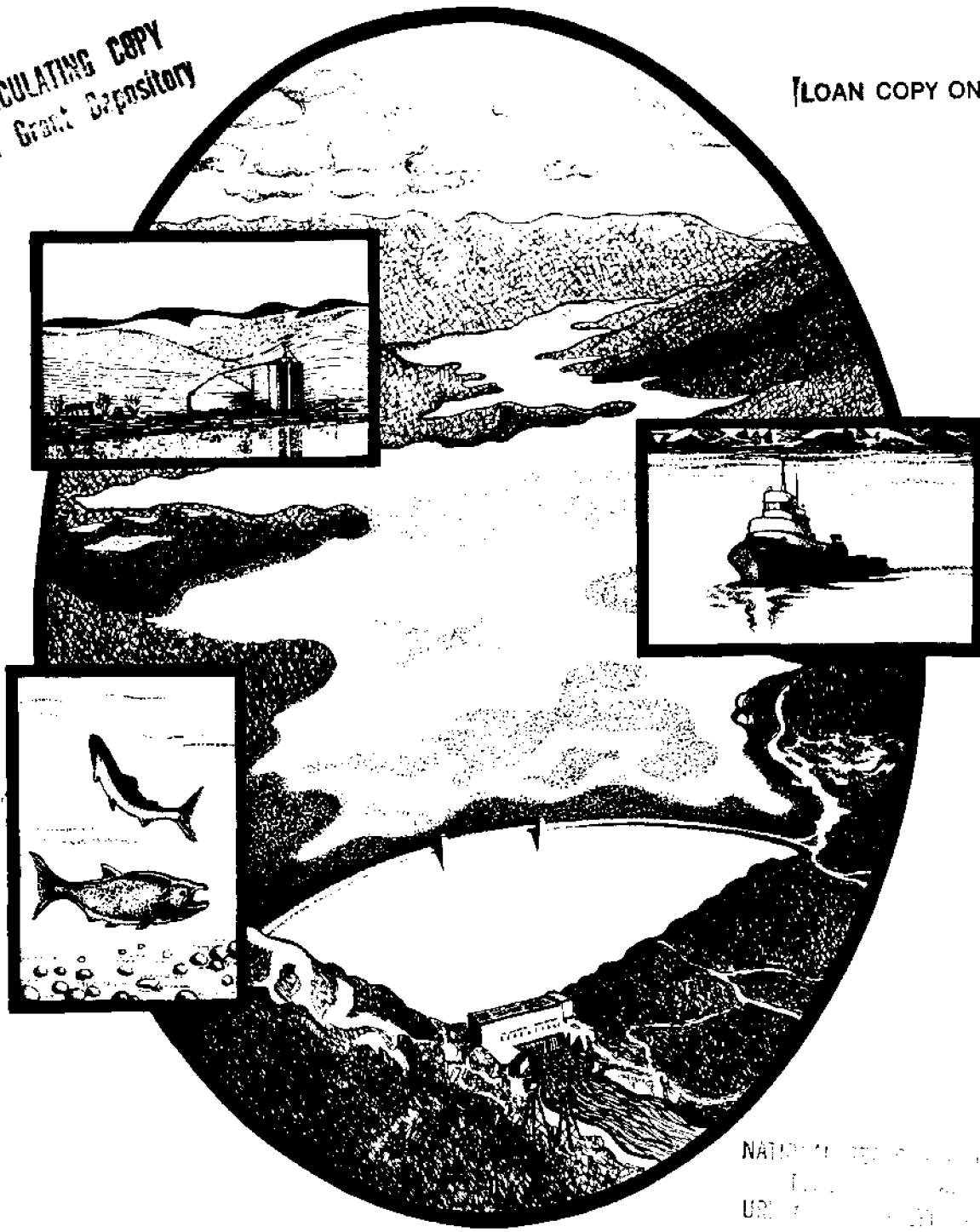


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The Columbia River: Its Future and You

Teacher's Manual for Grades 9-12

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The Columbia River: Its Future and You

Grades 9-12

Oregon State University
Sea Grant College Program
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TO TEACHERS

Introduction

This study of the Columbia River is designed as a multidisciplinary study incorporating the skills, competencies, and concepts of many different disciplines. It can be readily used by the social studies teacher or the science teacher, both of whom will find material from their areas. They will also find work for students in the basic skills which we all are increasingly expected to teach and reinforce.

Students completing this study will be well on their way to meeting the fundamental goal of education: to learn to be participants in their culture and not simply spectators of it. They will also be guided by two secondary goals of education: (1) to learn skills and competencies with which to demystify their culture; and (2) to gain knowledge and self-confidence in order to negotiate their environment. This curriculum, as you will see, involves reading in content, writing, math, decision making, problem solving, and invention; it appeals to logical and inventive thinking as well as inventive, creative thinking.

When students have finished this work, the following objectives will be met:

1. Students will understand the complex political and economic decisions to be made regarding future use of the Columbia and its tributaries.
2. Students will understand the impact of the Columbia River on their lives, the lives of past residents, and the lives of future residents.
3. Students will gain a historical perspective of the Columbia River and will understand specific aspects of its use: power generation, navigation, fisheries, agriculture, and recreation.
4. Students will practice applying the basic skills of reading, writing, computing, verbal communication, analytical thinking, and creative problem solving to the study of science and social studies.
5. Students will understand better the impact of their environment on their daily lives, their political system, their economic activities, and the history of their people.

This study of the river addresses as well the three stages of learning: acquiring information, making some personal sense out of information, and acting on the information. Each section of the study is developed to deliver all three stages to your students: they will

read and take in information; they will be asked to analyze and discuss that information; and they will be asked to solve problems, develop potential political and economic positions on issues, invent legends and theories, and take personal stands on delicate and complex concerns.

Especially in the third stage, the teacher needs to provide guidance and have patience. The discussions are often intended to be open-ended with no particular "right" answer. Indeed, eliciting a variety of answers is often more desirable than expecting one, predetermined answer. That is the heart of problem solving and decision making. For example, during the introduction and the conclusion, your students will be asked to simulate the positions of varying citizen groups on a complicated issue. You will need to help keep them from straying too far from "reality" and at the same time allow creative thinking and speculation to roam. Your students need such flexibility in order to get involved. We all do! Similarly, during the section on agriculture and irrigation, they are asked to consider the positions of a variety of taxpayers on a controversial issue. You must help them remember that all those people have complex reactions to economic concerns. They are special-interest individuals as well as people with personal convictions. This section will help the students see the probability of complicated emotions when they focus on the specific interests of taxpayers.

A word of caution is needed: students will often be asked to invent. In some cases they are asked to draw a map. Don't let their fear of the creative process prevent them from doing that. They will learn from the process of invention; you are not asking them to develop great products. Works of art are not being requested. Also caution them, when they are asked to invent a legend, that they are inventing their legend, not an Indian legend. To call their creations "Indian legends" would be presumptuous. Remember the message from Judy Annus, a highly respected Northwest educator, when she was informed that a particular school class was "making African masks." Her cool reply: "Do they do Renaissance paintings too?"

Although this material is developed as a nine-week mini-course or unit, the teacher is left with the crucial decision of whether to cut it into a shorter study or to lengthen it into a longer, perhaps semester, class. If you intend to lengthen, the section on "Suggestions for Advanced Study" is designed to give you ideas. It is assumed that the teacher can add to those suggestions as well as to the activities in each section. The suggested length of each section is intended only as a guide. The teacher, as mentioned, will likely think of more activities as well as alternatives. Also, decisions on testing, homework, review plans, and tempo are left to the teacher who is the best source for those decisions. If you limit your study to fewer than nine weeks, you will need to consider some materials from each section in order to retain balance in the study.

The materials in this study are designed so that as students proceed, they become involved. Warn your principal and brace yourself!

Topics and Suggested Length of Developed Materials

Introduction	4 days
History	10 days
Power	4 days
Navigation	4 days
Agriculture and irrigation . .	2-3 days
Fisheries	4-5 days
Recreation	4-5 days
Summary and conclusions	6 days

Suggestions for Further Study

Rationale

The activities suggested below were designed for the following situations:

1. A class wishes to interrupt the curriculum and study one issue or section in more depth.
2. A student individually or with a small group wishes to branch off and do a more in-depth study.
3. A student completes her or his work quickly and needs more homework or in-class activities.
4. A student finds regular schoolwork difficult and needs alternative assignments.
5. A teacher wishes to continue this study beyond the suggested time, perhaps to extend it into a semester elective course.

Suggestions

1. Read the publication The Columbia River Salmon: A Resource in Danger by Michael S. Spranger. PNW Extension Bulletin. Either write a short paper on a topic of your choice or do further reading on the salmon fishery and write a longer paper.
2. Try to locate the articles about Woody Guthrie that appeared in the Oregonian, August 13, 1983, and September 1, 1983. Arrange to have Guthrie's songs performed in class. Especially use the song, "Roll On Columbia."
3. Read Across the Wide Missouri by Bernard DeVoto or other books on the Rocky Mountain fur trapping activities in the 1830s. Study the history of fur trapping in the Rockies, the beginning of exploration of what was to become Washington, Idaho, and Oregon, and the origins of the Oregon Trail. Concentrate your study on how those developments were influenced by the Columbia-Snake system.
4. Read The River Within Us, a short booklet of poetry, essays, and brief articles on rivers large and small. This can be done as a reading project alone or as material for written projects. The booklet is published by the Institute of the Rockies, 622 Evans, Missoula, Montana 59801. It costs \$1.00.

5. Develop a series of questions regarding the political trade-offs in the use of Columbia River water and the question of state, regional, and national control over use and development. Interview your local politicians: state legislator, county commissioners, city council members, and so on, and compare their responses.
6. People are debating how the Columbia River gorge should be managed. Interview members of Friends of the Gorge, the Gorge Defense League, and other interest groups concerned about the gorge. Determine their positions and strategies. Define the different positions, reactions, and statements and try to determine the differences.
7. Write an annotated bibliography of resources (books, articles, speakers, tours, and so on) in your area. Your teacher can hand this out to next year's class.
8. Research the history of stern-wheelers on the Columbia, taking special note of reasons for their popularity and reasons for their decline.
9. Create a bulletin board or a chart that illustrates the products that arrive in the Northwest from other countries by way of the Columbia.
10. Create a display map that shows the Indian tribes that lived on the Columbia River. Demonstrate where their people are concentrated today.
11. Make a collection of Indian legends that contain references to the Columbia or Snake rivers.
12. Develop a fishing guide of fish that live in the Columbia and Snake rivers.
13. Create a map of the rivers that includes all the bridges that cross it. Research and write a short history of each bridge.
14. What wildlife populations depend upon the Columbia and Snake for their livelihood? Write a booklet describing the impact of the rivers on their lives.
15. Compile a guide of the different environmental groups interested in preserving the rivers, their tributaries, and the Columbia estuary.
16. Research the explorers of the Columbia River and create a tape or write a paper about their explorations.
17. Imagine the river does not exist. List all the things we would need to meet our daily requirements (train, truck, and so on) if this were true.

18. Plan a river trip from Astoria to Lewiston by small boat or canoe. Plan to get all your food and water from the river. Describe the clothing and tools you would need to take with you. Include information about the locks you would need to pass through on your journey. Explain how you would go about getting through the locks.
19. Create a historical graph showing the growth of towns and cities along the Columbia from the 1840s to the present.
20. Research the history of ferry boats on the river. Who did they serve? Where were they? How much travel did they make possible? At what points are there still no bridges today?
21. Compile a career guide for high school seniors interested in working on the river (fishing, bridge tending, river pilot, and so on). Get your information from a variety of sources, including interviewing.
22. Create a booklet for young children in which you illustrate and explain how a dam and locks work.
23. Create a crossword puzzle of the Columbia and Snake in which you focus on one of the following topics:
 - shipping and navigation
 - agriculture and irrigation
 - towns and cities along the rivers
 - plant and animal life on the rivers
 - Indian groups who lived along the rivers
24. Research women in history who are often overlooked, but who have had an impact on the use of the rivers. Include the present. Create a chart or bulletin board showing their contributions. A good source is the Women's Shipping Club in Portland.
25. Research a current issue regarding river use and write a letter to an appropriate elected official outlining your views.
26. Read The Journals of Lewis and Clark. Compare what Lewis and Clark said about the Columbia with what you have read during this study and what you already know.
27. Compile a list of all the sporting events that take place because of the Columbia, such as the Cross Channel Swim at Hood River. What were the origins of the event, what is its purpose, and how has the event grown? For the swimming and boating events, how are arrangements made with the dams to hold back water and with the locks to hold back traffic?
28. Find out if any new dams are being proposed or even thought about. Where? What changes will they bring?

29. Research ghost towns on the Columbia River system. When were they thriving? What industry did they serve? When and why did they fade out?
30. Research railroad lines that have served the Columbia region. How have they changed since 1900? Did the river make any differences in the changes?
31. Compile a cook book of fish other than salmon and steelhead that come from the Columbia and Snake.
32. Do an oral history project similar to the Foxfire one. Interview elderly people who live along the Columbia and write up their answers to your questions.
33. What plants are native to the Columbia region? Read about them, collect all that you can, and develop your findings into a presentation.
34. Paint, sketch, draw, or use some visual medium to portray wildlife or plants in the Columbia region.
35. Sit, listen, smell, watch, and observe the waters of the Columbia or some other river. Write what you sensed.
36. Collect data on weather patterns in the Columbia regions where you live. Record hot/cold, rain/sun, wind/calm, and so on.

Teaching Resources

Teachers are encouraged to send for the following materials for background information and use in class. Most of the items proved useful in preparing this curriculum.

Literature

Publications preceded by an asterisk are more technical than the others.

- *Are We Prepared for the Next Drought? May 6, 1983. Conference proceedings. WSG-WO-83-2. Obtain from Washington Sea Grant, 3716 Brooklyn Avenue N.E., Seattle, WA 98105-6795. (\$9.00)

Discusses the impact and implications that a serious low-water year (drought) would have on the Columbia River system and the Pacific Northwest. Papers are from major users and water managers of the Columbia River system. (135 pp.)

- The Columbia River: A Time of Decision and a Question of Balance, by Mike Spranger. October 1982. WSG-AS-82-2. Obtain from Washington Sea Grant, 1919 N.E. 78th Street, Vancouver, WA 98665. (Free)

This advisory report gives a broad overview of the multiple uses of the Columbia River and discusses emerging conflicts and trade-offs.

- The Columbia River Gorge: A Unique American Treasure, by Mike Spranger. EB 1193. Obtain from Ag Bulletin Room, Washington State University, Pullman, WA 99164-5912. (\$5.25/bulk discount available)

Provides an overview of the history, geology, ecology, and development of the Columbia River Gorge. It contains detailed maps, historical photographs, and extensive bibliography. (76 pp.)

- The Columbia River Gorge Coloring Book, by Charles Martin. Available from Eagle Sign, P.O. Box 21, Hood River, OR 97031.

Shows wildlife and historic events that occurred on the river.

- Columbia River Projects, a pamphlet on Bonneville, The Dalles, and John Day dams. Obtain from Portland District U.S. Army Corps of Engineers, 319 S.W. Pine, Portland, OR 97204. (Free)

Describes the operations, management, and multiple purposes of these major Columbia River dams.

- Columbia River Salmon, A Resource in Danger, by Mike Spranger. 1983. Obtain from Washington Sea Grant, 1919 N.E. 78th Street, Vancouver, WA 98665. (\$1.00)

Describes the rich history and life cycle of the Columbia River salmon and discusses the many reasons which led to the decline of this resource. Also outlines several ongoing efforts to preserve and enhance fish resources within the basin.
- *The Columbia-Snake: Challenges for Multiple-Use River Management. 1981. PNW Bulletin 212. Obtain from Malling Services, Oregon State University, Corvallis, OR 97331. (25¢)

A 15-page publication describing the many uses, conflicts, and trade-offs of the Columbia River system.
- *Control and Management of the Columbia-Snake River System, by Philip R. Wandschneider. 1984. XB 0937. Obtain from Bulletin Office, Washington State University, Pullman, WA 99164-5912. (Free)

Reviews the institutional agencies and decision-making processes that are involved in managing the Columbia River system.
- *Energy Trade-offs and Economic Feasibility of Irrigation Development in the Pacific Northwest, by Norman Whittlesey, et al. 1981. Ag Research Bulletin 0896. Obtain from Ag Publications, Washington State University, Pullman, WA 99164-5912. (Free)

Describes irrigation development in eastern Washington and trade-off issues between energy and water.
- *Magnificent Gateway, by John Allen. Obtain from Timber Press, P.O. Box 1632, Beaverton, OR 97075. (\$8.50)

A book describing the geology of the Columbia River and Columbia River gorge. It also contains a mileage road log, excellent for self-instructed field trips on the geology of the gorge.
- *The Making of Oregon: A Study in Historical Geography, by Samuel N. Dicken and Emily F. Dicken. Obtain from the Oregon Historical Society, 1230 S.W. Park, Portland, OR 97205.

This book discusses the natural history of Oregon.
- *Navigation and Commerce on the Mid-Columbia/Lower Snake River System, by William McNamee and Lewis Queirolo. 1981. PNW #213. Obtain from Ag Publications, Washington State University, Pullman, WA 99164-5912. (25¢)

Gives an account of the water transportation system of the Columbia and Snake rivers.

- *Oregon Wet High and Dry, by John Dart and Daniel Johnson. Obtain from Hapi Press, 512 Maplecrest Drive, Portland, OR.

A natural history of Oregon, this book includes information about geology, vegetation, soil types, wildlife, and so on.

- *Oregon's Smaller Ports: What They Do and How They Are Financed, by Wilson E. Schmisseur, et al. 1979. EC-979. Obtain from Mailing Services, Oregon State University, Corvallis, OR 97331. (25¢)

Surveys the smaller ports of Oregon, their responsibilities and functions, and their finances.

- *Politics and Economics of Columbia River Water. October 26, 1984. Conference proceedings. Obtain from Washington Sea Grant, 3716 Brooklyn Avenue, N.E., Seattle, WA 98105-6795. (\$9.00)

Presents the political, economical, and technical questions that must be addressed in operating and managing the Columbia River system. Contributors include senators, department heads of federal and state agencies, major users, and key water managers. (130 pp.)

- *The Role of the Columbia/Snake Navigation System in Intermodal Ocean Transportation, by James R. Jones. ORESU-T-80-001. Obtain from Sea Grant Communications, AdS 402, Oregon State University, Corvallis, OR 97331. (Free)

Discusses the Columbia-Snake River navigation system and its potential as a major waterway; it also describes new techniques in transloading commodities aboard ocean vessels.

- "The Snake River Country." Resource Inventory Map. Obtain from Washington Sea Grant, 1919 N.E. 78th Street, Vancouver, WA 98665. (Free)

This 17" x 23" map has a narrative which discusses the history and major uses of the Snake River. It outlines the river basin and identifies visitor centers, parks, museums, and historic sites situated along the river.

- The Dalles Lock and Dam, a pamphlet. Obtain from Portland District U.S. Army Corps of Engineers, 319 S.W. Pine, Portland, OR 97204. (Free)

Describes the operations, management, and multiple purposes of this Columbia River dam.

- *Waterway User Fees and Wheat Transportation in the Pacific Northwest, by Ken Casavant, et al. PNW #230. Obtain from Ag Publications, Washington State University, Pullman, WA 99164-5912. (25¢)

Describes wheat transportation within the Columbia River basin and the effects water user fees will have on barge and truck traffic.

- Write to ports such as Longview and Portland for pamphlets they print. Some also have slide programs they may provide.
- Write to your state department of tourism and local chambers of commerce for informational brochures that they may have in print.

Audio-Visual Materials

Material marked with a dagger is suitable mainly for grades 5-8; that marked with two daggers is more appropriate for grades 9-12.

† Estuary: Columbia's Link with the Sea. Available from Sea Grant Communications, AdS 402, Oregon State University, Corvallis, OR 97331. This 28-minute 16mm film points out the importance of the Columbia River estuary. It also discusses the multiple uses of the Columbia and how they affect the estuary and individuals who use the estuary.

† Sparkle. Available from U.S.F.S., Dept. of Agriculture, P.O. Box 3623, Portland, OR 97202. A visual poem follows a wild mountain stream from its source high in a pristine side canyon of the gorge down to its meeting with man.

†† The Columbia River: A Time of Decision and a Question of Balance. 1981. Obtain from Washington Sea Grant, 1919 N.E. 78th Street, Vancouver, WA 98665.

This 15-minute slide-tape program presents an overview of the uses of the river and discusses the complexity, interrelatedness, and potential conflicts in using the river for multiple activities.

†† Livable Streams. A slide-tape set produced by the Bureau of Land Management suitable for 9th grade to adult. Covers the relation between land use and water quality in streams. Fifteen minutes. For information, contact the Bureau of Land Management, 729 N.E. Oregon, Portland, OR 97232.

†† Steamboats of the Columbia. Available from the Oregon Historical Society, 1230 S.W. Park, Portland, OR 97205. Slide program showing the importance and historical role of steamboats on the Columbia.

†† The Columbia River Gorge: A Natural History. Available from Northwest Film Study Center, 1219 S.W. Park Ave., Portland, OR 97205. Student-produced 16mm film which shows the formation of the gorge by floods. Also includes information about the natural history of the gorge.

- † Journey of the Kings. Available from Northwest Power Planning Council, 850 S.W. Broadway, Suite 1100, Portland, OR 97205 (free). (Ask for 15-minute version.) This 16mm film discusses the plight of the Columbia River salmon and the remarkable regional program designed to protect them. This beautiful movie soars over some of the most stunning landscapes in the world as it follows the salmon from their upriver spawning grounds, through the mighty dams, to the sea, and back again.
- † Pass Creek. Available from U.S. Fish & Wildlife Service, Lloyd 500 Building, Suite 1692, Portland, OR 97232. Describes the effects of careless logging on small streams. The Oregon setting relates the effect of logging on steelhead trout.
- † Dammed Forever. Available from U.S. Fish & Wildlife Service (see above), or U.S. Fish & Wildlife, P.O. Box 25486, Denver Federal Center, Denver, CO 80225. Traces the changes in major waterways and their streams when a series of dams is built. Shows the influence on wildlife and water quality. Focus is on fish life.
- † Columbia River Gillnetters. Available from Extension/Sea Grant, AdS 422, Oregon State University, Corvallis, OR 97331. Describes types of boats and nets and methods used in local gillnet fishery for salmon; identified areas fished; follows fish from catch to delivery to processor.

Other Resources

Contact a local port for possible field trip, outside speaker, or written materials. For example, the Port of Portland offers the following:

- Tours of the Port
Can be adapted to any age level. Requires groups of 20 or more.
- Van Program (Grades 3-5)
A 38-foot trailer used to teach curriculum regarding the port and Oregon's role in international trade.
- Suitcase Program (Grades K-12)
Guess What I Am (K-3): A discovery session for younger children.
Careers in Marine Trade (7-12): Presentation of career possibilities at the port.
Maritime History (5-12): Presentation of the history of the Columbia River and the growth of Portland as a major world seaport. Includes artifacts, slide presentation, and discussion.

- Speaker's Bureau (High School-Adult)
A presentation of current issues facing the port.
- Contact a dam near you and arrange a tour, if your school district allows it. Students can watch a fish ladder in operation, see the turbines, learn about the spillway, and get some history on the development of the dam.



Introduction

Introductory Activities

Before you begin this study of the Columbia River system--its history, its uses, and its effect on the lives of people for 12,000 years--do the following:

- A. Write to a town on the Columbia River system. Any town. Send your letter either to the Chamber of Commerce or, if the town is especially small, to the local newspaper. Ask these questions:
 - How did the town get its name? If the town has an Indian name, what does it mean in English?
 - What effect does the Columbia River have on the town's development, economy, employment, and unusual activities, such as a yearly festival?
 - Is the town growing or declining in population, and what effect does the river have on that?
 - What recreational opportunities are available in or near the town? (You will need this for an assignment later.)

Ask your source to send you whatever other information may be available on the town. Indicate that you need the material for a class assignment and you would like to have it as quickly as possible.

Send a self-addressed, stamped envelope along with your letter because you will need your reply before this study is completed.

Make certain your letter has all words spelled correctly, good punctuation and grammar, and complete sentences.

- B. Draw in the Columbia on the following blank map. Place in the following: Astoria, Portland, Vancouver, the Willamette River, The Dalles, the Snake River, Grand Coulee Dam, Pasco, the Washington-Canadian border, Lewiston, Longview, Bonneville Dam, and the states of Idaho, Oregon, and Washington.

If this is difficult, don't be embarrassed. You will know the river by the time your study is finished. How well do you know it now?

- C. Look at the map at the end of this section. Find what subdivision you live in. What is the name of the subdivision? Compare the map you just drew with this one.
- D. Complete the Hidden Word Puzzle. After doing it, discuss in class each word, making certain all the words are understood.
- E. Start the following discussion:

The entire class should pick one of these tributaries of the Columbia River system:

The Clearwater River
The Boise River
The Deschutes River
The Lewis River
The Spokane River

Answer the following questions by using a map, atlas, or other resource:

1. What major towns and cities are situated on the river?
2. What state and county are they in?
3. What dams and industry are near?
4. Is the area used much for agriculture?
5. Is the area a popular recreation and sportfishing site?
6. What other significant areas are located on the river: hatcheries? wildlife refuges?

Now discuss in class or small groups the following?

1. Assume some county commissioners want to develop the land around the mouth of the river for a public park with boat ramp, fishing access, swimming, picnicking, and hiking trails. They plan to use 1,280 acres (two square miles) for this purpose.

Which of the following groups would likely support the idea? Why?

- Small retail business in nearby towns
- Industry nearby and located on the tributary
- Conservationists
- Farmers whose land is on the tributary, near the site

(E. continued)

- Local sheriff
- Bankers in the nearby towns
- Citizens of the towns who enjoy outdoor recreation
- Fishermen
- Indians
- Local Chamber of Commerce
- Local public utility commission
- Federal and state agencies

2. Why do you think the groups you left out would not support the plan?
3. Which people who usually are on the same side of an issue would generally be in opposition to each other? Why? What arguments do you think the opponents would use against the plan?
4. How would you vote if you were on the Board of County Commissioners? Why? Compare your vote with that of other members of the class and discuss these questions.
5. How might this situation change if there were plans to develop a 1,000 megawatt, coal-fired, electric generating power plant on this site rather than a public park? What differences would there be in opposition to the plan? Why?

Keep track of your ideas in this activity. In discussing this issue and in making your decisions, you are going with your hunches, the knowledge that you already have, and your biases and opinions. When you complete this study, you will have more information to help you make a more rational, well-informed decision than you can at this time. The point is, the Columbia River, like any other river or any mountain or meadow, is only so large. It is not getting larger. If additional use is planned, someone must reduce his or her use.

If you have only enough chairs in your classroom for each student to use one, and you desire two, someone will have to give up his or hers. The student won't like that, and will try to convince your teacher that your desires are not only unnecessary, but harmful. You will need to convince your teacher that, not only is your request legitimate, but in all likelihood the entire class will benefit from your having two chairs.

(E. continued)

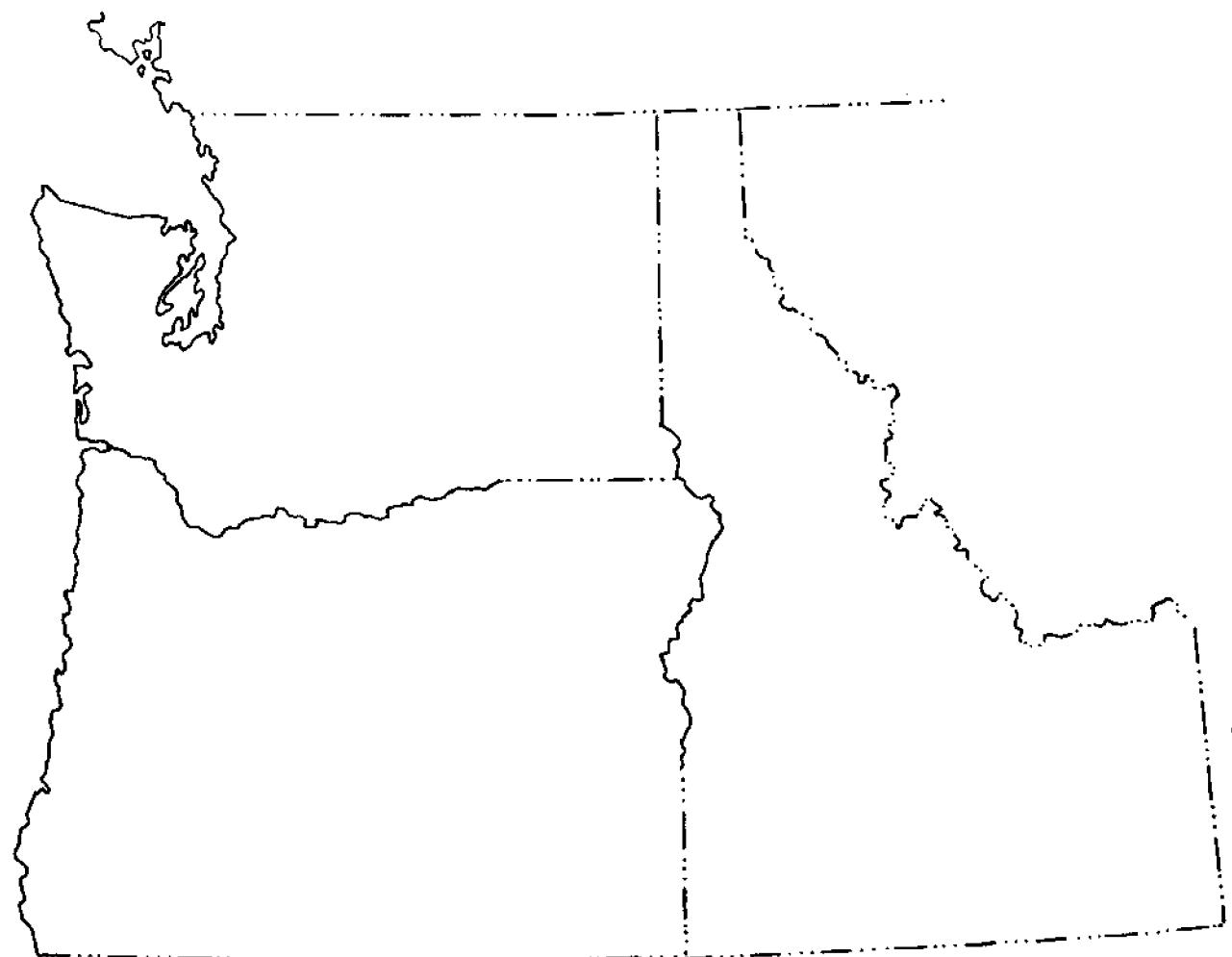
So it is with politics. The Columbia River is definitely a political arena. With the construction of dams, some people gain and some lose. Industrial pollution benefits some and hurts others. Diversion of water for agricultural purposes (irrigation) helps some and diminishes the water supply for others (power generation, for example). It is a series of trade-offs. There simply may not be enough water for all of us to do everything we want with it.

After you read the above, think through your group's answers to and disagreements with the questions you completed. At the conclusion of the study of the Columbia, you will work on the same questions.

F. Take the following pretest:

1. In what directions does the Columbia River flow?
2. Where is the source of the Columbia?
3. How large is the Columbia River system in length; in square miles?
4. What is the name of the city at the mouth of the Columbia?
5. What is the largest tributary of the Columbia?
6. Approximately how long have people lived along the Columbia?
7. What is the first dam upstream from the mouth of the Columbia?
8. Which of the following is not a major use of the Columbia:
(a) fishing, (b) agriculture, (c) navigation, (d) recreation,
(e) power generation, (f) scenic, wild river?
9. Which of the following is a major city on the Columbia:
(a) Spokane, (b) Portland, (c) Seattle, (d) Boise?
10. Why is there political controversy over use of the river?

Correct your own test from the answers on the next page. It will not be graded. At the end of this study, you will take it again and then compare your results. It is not expected that you will get many correct answers now.



Answers to Pretest

1. north, west, south, west, north, west
2. Columbia Lake in British Columbia, Canada
3. The Columbia River flows more than 1200 miles before it enter the Pacific Ocean.

The river and its tributaries drain nearly 260,000 square miles--an area comparable to that of the nation of France.

The Columbia is the largest North American river flowing into the Pacific Ocean. Its flow is ten times that of the Colorado River. In the United States, it is second only to the mighty Mississippi River in average annual runoff.
4. Astoria, Oregon, which is named after John Jacob Astor, a famous explorer and trader
5. Snake River
6. 12,000 years
7. Bonneville Dam, named after the early explorer, Captain Benjamin Bonneville
8. scenic wild river
9. Portland, Oregon
10. All the water in the river is now being used. Every decision involving a present or future use now requires a trade-off. A trade-off means making a decision to trade the benefits of one thing to gain increased benefits from another. These decisions become political because all groups want to maintain or increase their use of the water.

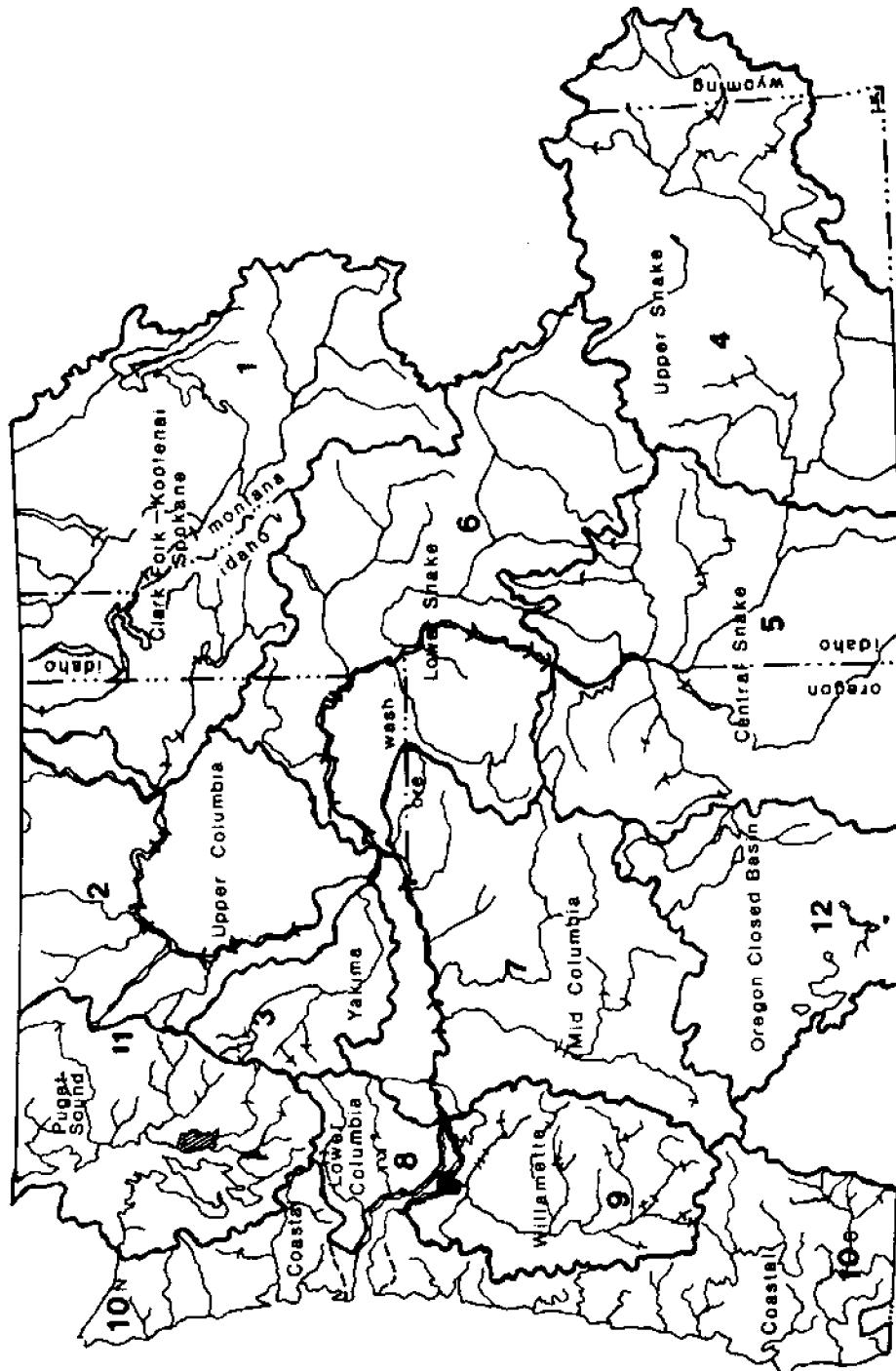
Hidden Word Puzzle

KILOWATT OZ Q COLUMBIA V D C M
D F G R H S J M T P A X F L R L C W B R A A J
R S P I L L W A Y N H U E S M Z C V A S I P W
B D O V E E E I A S O C K E Y E T L C W Y X A
L L G E H H O D N R L C F I S H L A D D E R S
E M O R W B A E E G O F X S Z A D Q J A S U H
C H H L B G N W N L B N C L M E K S G E H C I
A J O M O A O E E P O R Q A S T W T A H L S N
R O C O R P S O F E N G I N E E R S K L A T G
L R S C W M P X G G N H R D S E T O I E M N T
I E N G A N T R Y C E L A A G E W A U E P O O
A G W K D D U X T O V M A R F E R G O T R I N
T O A I M T R D I F I B A C F T Y G R S E T C
T N P L S R B R C I L B R A I N B O W T Y A H
E O S L X A I O I N L Y B V T C T R Q X K G S
V W C D E O N F R G E U C C R A R G D C C I M
S E V E E R E D T E R G H M R U O E A O E V A
D X C E B H O A C R U X I E M M N B T L R A S
O S P R E L R E L R C N A R D E K G N N N F
Y E L I W D K B L T A E O L U U L A L U U R M
C W A T E R S S E N G R O C L P E L T E T O G
B Z Y D W O T F H G R M K B R E M M I Z S F C

See if you can find these words in the puzzle. You can play many different ways. For example, let one person find all the fish-related words, while another finds the birds, and so on. You might want to use different colored highlighters for each category. Good luck, and have fun.

FISH LADDER	CANADA GOOSE	CORPS OF ENGINEERS	POWER
COUNTER	MALLARD	RONNEVILLE	GENERATOR
SALMON	EAGLE	COLUMBIA	HYDRO
FINGERLING	OSPREY	RIVER	GANTRY
SPAWN	GULL	GORGE	ELECTRICITY
BLUEBACK	DOVE	WASHINGTON	TURBINE
CHINOOK	KILLDEER	OREGON	KILOWATT
COHO	DUCK	TRAIL	SPILLWAY
SOCKEYE		LEWIS AND CLARK	TAILRACE
TROUT		CASCADES	SWING BRIDGE
STEELHEAD		BRADFORD	NAVIGATION
RAINBOW		ISLAND	LOCKS
STURGEON		WATER	CRANE
SHAD		DAM	TUGBOAT
LAMPREY			BARGE
			LOGRAFT
			WHEAT

MAJOR SURFACE WATER FEATURES AND SUBDIVISIONS





History

History: A Reading

The River

Some facts of history never change. From its earliest beginnings, the Columbia River has originated in the high country of eastern British Columbia, Canada. The Snake River, the Columbia's main tributary, has its origins in the high country of Yellowstone National Park in Wyoming. In fact, the two river systems that dominated the shaping of our nation's western history, the Columbia and the Missouri, have origins very close to each other--less than the distance from Seattle to Portland. The Missouri River originates north of the Snake, in the Rocky Mountains, The Missouri drains the eastern slope of the Rockies, entering the Mississippi River near St. Louis, Missouri. The Columbia-Snake drains the western slope of the Rockies and enters the Pacific Ocean between the states of Washington and Oregon at Astoria, Oregon. These rivers were important transportation routes for the early explorers, such as Lewis and Clark, and the early settlers who gradually claimed this land for the United States.

Some facts do change. About 6 to 7 million years ago the Columbia changed course, taking its present route: it ran from its source northward in British Columbia, made a 180° turn, flowed southward into eastern Washington, received the waters of the Snake near present Pasco, Washington, turned westward to Portland, and then north to Longview and west again to the sea. This change was the result of floods, landslides, and volcanic eruptions that would make the recent eruptions of Mt. St. Helens look like a low-budget Fourth of July celebration. The first evidence we have of these eruptions occurred 40 million years ago.

The Columbia-Snake river system is one of the great rivers of the world. The Columbia drains an area of over 262,000 square miles. This includes most of Idaho, about two-thirds of Oregon and Washington, the western third of Montana, small portions of Wyoming, Nevada and Utah, and part of British Columbia. This land equals an area the size of France!

The annual surface water runoff at the mouth of the river averages 256 million acre feet, which equals a continuous flow of 350,000 cubic feet per second entering the Pacific Ocean.* This ranks the

*In terms somewhat more relevant to everyday life, one acre foot equals 1,000 liters or 264 gallons. Thus, the average surface water runoff at the mouth equals 67,584,000,000 gallons. This is about 1.16 times the total annual water consumption of approximately 90 percent of the residents in King County (including Seattle, Washington).

Columbia fourth among North America's great rivers. Only the Mississippi, the St. Lawrence, and the Mackenzie are larger. In comparison with other great rivers, the Columbia exceeds twice over the flow of the Nile. Its flow is also more than ten times that of the Colorado. In the United States, only the mighty Mississippi River has a greater flow of water than the Columbia.

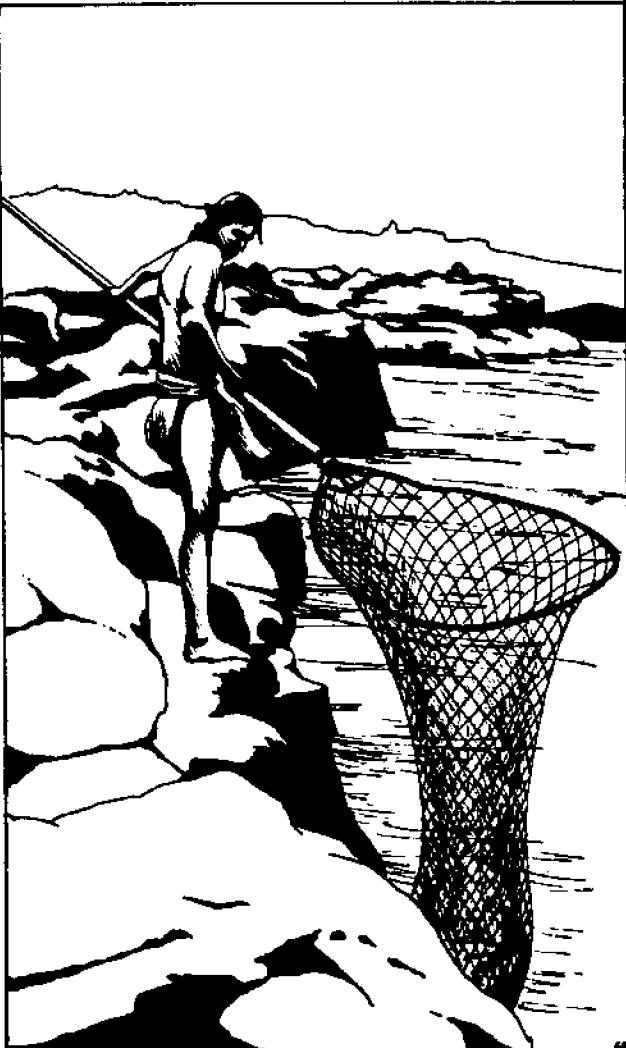
The Columbia flows over 1,200 miles from its Canadian origin until it enters the Pacific Ocean. Twenty percent of this water is provided by the Snake and its tributaries. This complex system, the Columbia-Snake, has been a center of economic activity since the first people occupied these lands.

The First Inhabitants

From the dawn of early civilization, people have lived along the banks of the Columbia. Anthropologists claim people have lived in this area for over 12,000 years. Textbooks call the period 12,000 years ago

ancient. It is! The first dated evidence of a settlement, the oldest continuously occupied permanent village known to us in the Columbia area, was found near the present site of The Dalles, Oregon. This village, known to the Indians as Wy-am, dates back over 10,000 years.

Rich native cultures developed and flourished along the Columbia's banks. These early people engaged in fishing, trading, art, and everyday living. Among these people were the Chinook Nation which claimed as its territory land from Wy-am to the Pacific Ocean. The Sahaptin Nation claimed territory east of Wy-am. On the Snake River, the Shoshone, Bannock, Nez Perce, and Paiutes claimed the land as theirs.



WISHRAM DIPNETTER

These people all shared in the bountiful salmon of the Columbia. Annually, these tribes would meet at Wy-am near the ancient fishery grounds of Celilo Falls to trade. Here the natives of the interior traded dried salmon, hides, and baskets for the shells and woven bark of the coastal tribes. This culture flourished for thousands of years until the early 19th century when "invaders from the east" came; they would completely disrupt this ancient way of life.

The Explorers and Settlers



The Columbia River was the last major river "discovered" and developed in the United States. Since the 16th century, Europeans had traveled along the Pacific coast hoping to discover the "Mysterious River of the West" which would connect their countries with the riches of the Orient. Despite this extensive search, the Columbia River was not discovered by explorers until 1792 when an American from Boston, Captain Robert Gray, entered the mouth of the Columbia.

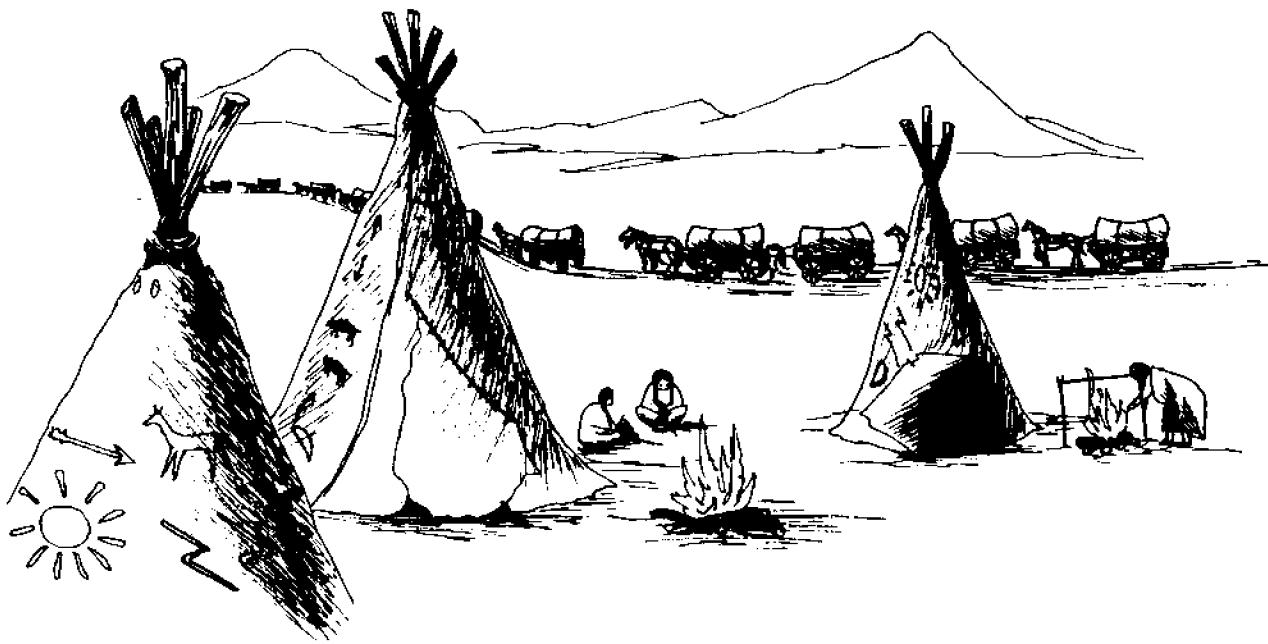
Although the river did not lead to the riches of the Orient, the land was rich in natural resources. Word of this rich area spread. The invasion began.

In 1805, captains Lewis and Clark, on a mission from President Thomas Jefferson, entered the Snake-Columbia region in their efforts to explore and map the great land of the west. After them, other explorers established a settlement in 1811 at Astoria, and isolated fur trappers began making their way along the upper Snake. Fort Vancouver was established by England's Hudson Bay Company in 1825. After that, things moved fast.

The mountain men made their living on a thriving fur trade all along the Snake tributaries: Jedediah Smith and his men took a hot, dry

route from the Rockies to California and up into Oregon from the south. After a disastrous experience with Indians in southern Oregon, he made his route to Fort Vancouver by going down the Willamette.

In the 1830s, missionaries Jason and David Lee and Marcus Whitman established Christianity as the new religion of the Indians in the Willamette Valley and also near the present cities of The Dalles, Oregon, and Walla Walla, Washington. The missionaries brought many features of the white culture to the area, the most important of which was the practice of agriculture. They also publicized the riches of the area to the people of the East. It was only a short time later--in the 1840s--when wagon trains bringing settlers over the 2,000 miles of the extremely hazardous Oregon Trail entered the Columbia region by way of the Snake. More followed, and still more, bringing United States customs and ways to the region.



These invaders began to claim the land for themselves, altering the lifestyles that had existed for thousands of years. These people brought disease, which eventually killed most of the earlier people, and plows which tore up their land.

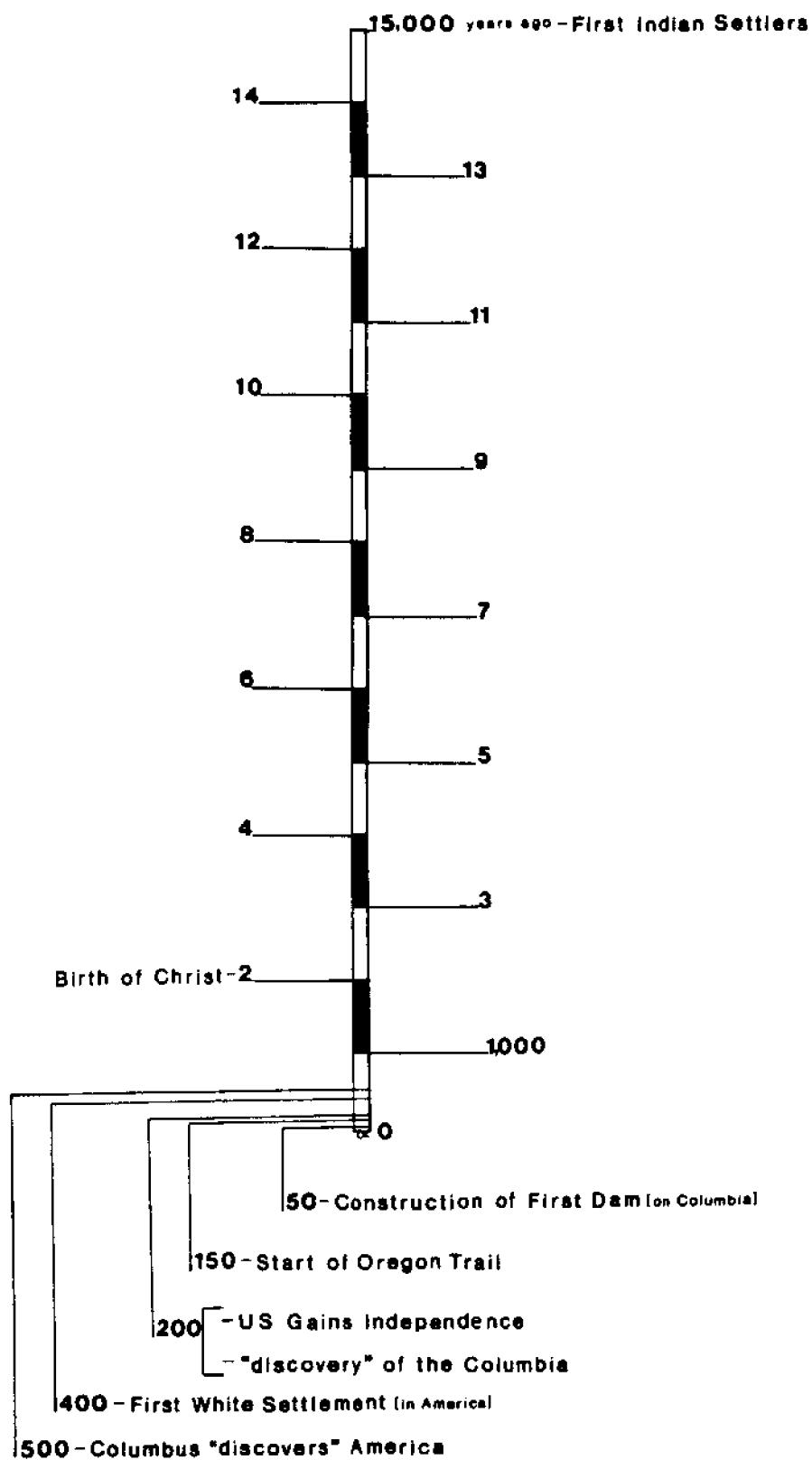
In 1848, 12 years before the Civil War broke out, the United States established the Oregon Territory, the first territory that nation claimed west of the Rocky Mountains, its western boundary at that time. The Oregon Territory was huge. It comprised what are now the states of Oregon, Washington, Idaho, and part of Montana and Wyoming.

This huge claim of land was made to establish "law and order" over an area where for 12,000 years the original inhabitants did things their own way. Afraid of the disease and disgusted with the plow and land claims, some of the natives fought back. Because they retaliated against the taking of their land, they were rounded up onto reservations by the military Territorial Government. The nation to the east was stretching and flexing. Some nations with claims, like England and France, left the area. Other nations--like the Chinook and the Sahaptin--were defeated because they had no other place to go.

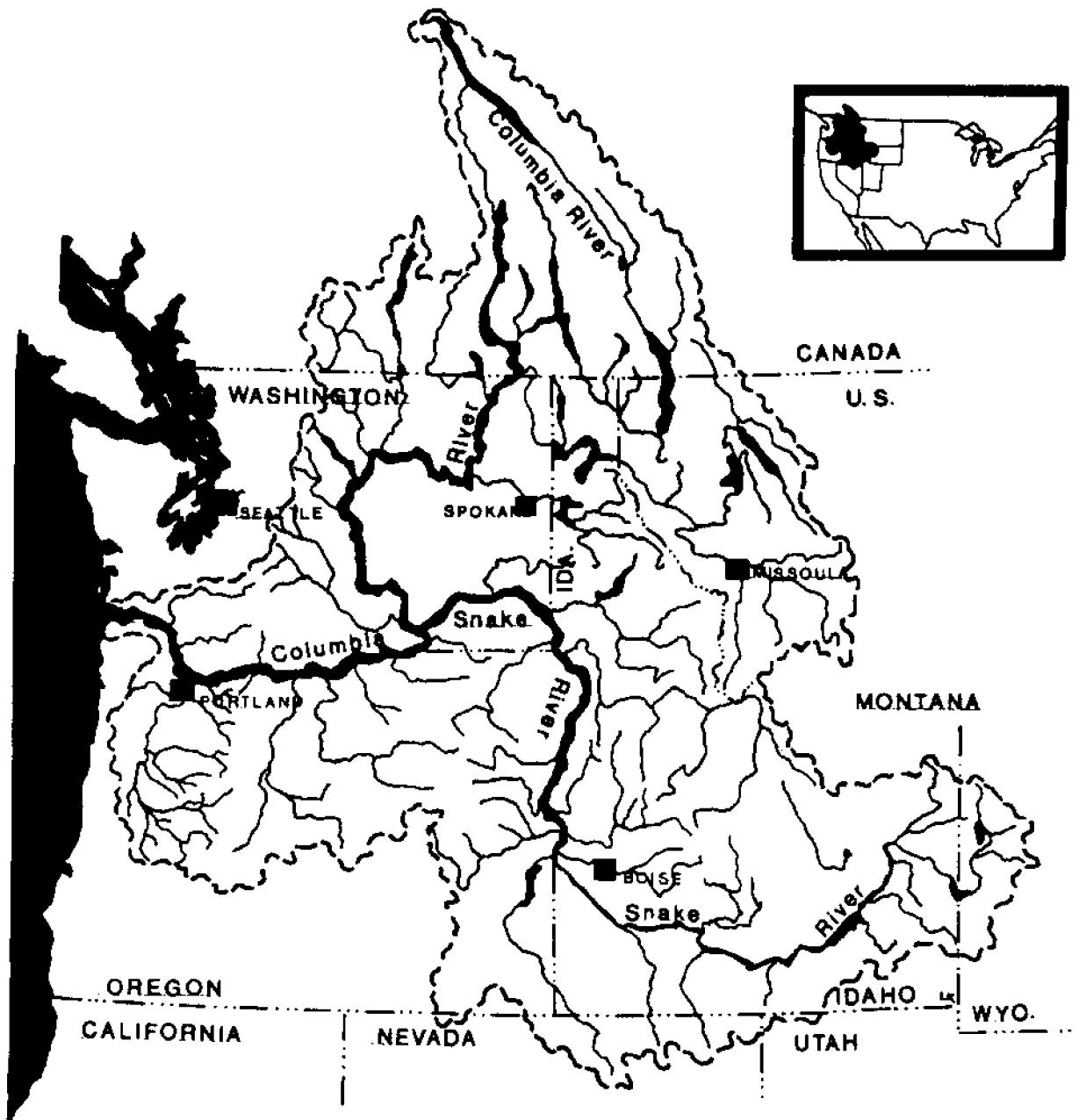
Within a short span of time, some 50 years, the Columbia River had become a United States "resource"--at least, the Columbia south of the Canadian border. The origin of the river still remained in the high country of British Columbia, for some things never change.



HUMAN USE OF THE COLUMBIA



THE COLUMBIA/SNAKE DRAINAGE SYSTEM



Lesson Activities

I. Concepts, Phrases, Words, and Numbers

Write and discuss definitions to the following:

1. tributary
2. origin
3. source
4. volcanic eruption
5. evidence
6. economic activity
7. inhabitant
8. emigrant
9. continuously occupied village
10. retaliate
11. isolated
12. thriving
13. disastrous
14. settler
15. hazardous
16. missionary

II. Class Activities

On a map, find the Pacific Northwest, then complete the following activities:

1. Identify the sources of both the Columbia and the Snake Rivers
2. Identify the following tributaries:

Snake - Clearwater

Salmon

Payette

Boise

Columbia - Spokane

Umatilla

John Day

Willamette

Lewis

Cowlitz

3. Identify the following sites in the Columbia River basin:

Walla Walla, Washington

Pasco, Washington

The Dalles, Oregon

Portland, Oregon

Vancouver, Washington

Astoria, Oregon

Lewiston, Idaho

Salem, Oregon

Idaho Falls, Idaho

Twin Falls, Idaho

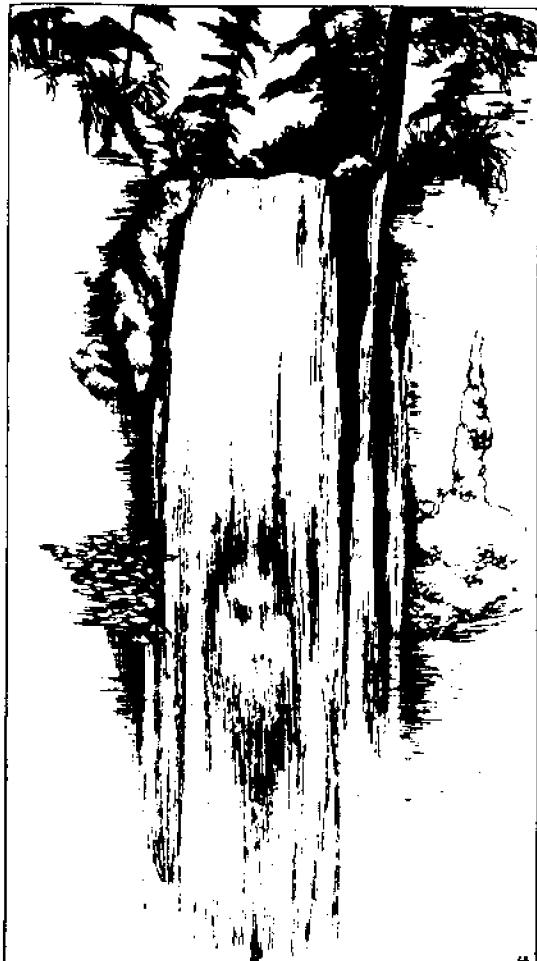
4. Outline the Oregon Territory.

III. Class Discussion or Written Assignments

1. What are some of the reasons we have relatively little information on Indian life on the Columbia, even though it goes back 12,000 years? Discuss the lifestyle and living conditions of these people.
2. On the map, look at the territories occupied by the various Indian tribes. How were these tribes similar? What differences were there among these tribes?
3. If the Columbia "pumps over 128,000 gallons of water" into the Pacific Ocean every minute, is that water wasted as a human resource?
4. Do you agree with calling the "people from the east" (early white settlers) Columbia region "invaders"? Explain.
5. Why was the plow seen by the Indians as such a disaster to their way of life?
6. Develop a plan for the 1840-1860 period for Indians and settlers to coexist on the Columbia and its region without war. Think of reasons your plan was not used.
7. Why did President Thomas Jefferson want the area west of the Rockies explored? He had just bought the Louisiana Purchase Territory from France, but it extended only to the Rocky Mountains.
8. Imagine that you are a member of the Lewis and Clark expedition, the first white persons to enter this wild, unexplored territory. Discuss the adversities, dangers, and hardships you endured during your three-year exploration of the West.
9. Imagine the first meeting between the white settlers and the Indians. What do you think they discussed? What differences were there in their cultures? What was similar in their cultures? Discuss why the attitudes they had for one another changed over time.

Changes in the River: A Reading

Near the end of the Ice Age--between 12,000 and 19,000 years ago--a huge ice dam in the region of what is now northern Idaho and western Montana created an enormous lake (known as Lake Missoula). Waters backed up over 250 miles, creating a lake about half the size of the present Lake Michigan. After many years these waters eroded away this ice dam. Suddenly a great force of water rushed over the dam, raced into eastern Washington, flooded most of southeastern Washington, and helped carve out the Columbia Gorge that separates Washington and Oregon between The Dalles and the Sandy River just east of Portland. Geologists theorize that over 47 separate floods of this type could have occurred during these 5,000 years. These were no minor floods. The water flowing through this area during the floods has been estimated to be ten times the combined flow of all the rivers in the world.



This raging series of floods had elevations ranging from 1,000 feet above sea level to 600 feet near Portland, and 400 feet down the Willamette Valley, covering land as far south as what is now Eugene, Oregon. Geologists estimate these tremendous floods occurred over 40 times, at intervals of 175-200 years.

The effect of these great floods on the land was spectacular. It is nowhere clearer than in the Columbia Gorge where famous waterfalls, such as Multnomah Falls, demonstrate how rivers were left hanging by the force of the rushing water. In fact, some refer to these falls as "hanging rivers," rather than waterfalls.

It has been estimated that one flood came through the gorge at a rate of 1.66

cubic miles of water an hour for two to three weeks. Can you imagine the impact of 1.66 cubic miles an hour?

When the floods receded, the Columbia was left for many centuries a wild river flowing freely and rapidly to the sea. About 700 years ago (the time of Gengis Khan), a landslide near what is now Bonneville Dam caused that section of the gorge to narrow, forming dangerous rapids called the "great cascades." They became a considerable threat to river transportation and travel. In the 19th century, many pioneers who had survived the difficult Oregon Trail lost their lives trying to float their covered wagons on barges through the rapids. After months on the trail within 50 miles of the Willamette Valley, some of these pioneers didn't make it because the river was too wild.

In the early part of the 20th century it was decided to tame the river for flood control, navigation, irrigation of crops, and electric power generation. Modern civilization came to the Columbia. Navigation canals were built around the great cascades (1896) and Celilo Falls (1915). In the 1930s during the Great Depression, the construction of dams began. Construction has continued into the present. Bonneville Dam was built, providing jobs to many who were unemployed during the depression. Then came Grand Coulee Dam in eastern Washington. Now there are major dams all along the Columbia and the Snake. This Columbia-Snake system, no longer a wild river, is often described as a series of lakes. The dams accomplished many things. Jobs were provided, irrigation of agricultural land was increased, electrical power was generated, flood waters were brought under control, and navigation locks made it possible for grain and timber to be shipped from Lewiston, Idaho (465 miles from the Pacific Ocean), to nations across the Pacific. In fact, Lewiston now connects huge agricultural areas east of the Rockies with markets across the Pacific Ocean.

However, in taming the Columbia, people have destroyed wildlife habitat, reduced or eliminated salmon runs, and submerged scenic and historical areas. You need to decide what you think about that. Remember the discussion you had about trade-offs? Trade-offs have been made, and the final chapter on the history of the Columbia might be that it no longer can provide enough water to meet all our needs. When Bonneville Dam was first built, some critics said it would provide more electricity than we could ever use. That has proven to be a mistaken assumption. We all need to think about these questions: Have we overdone it? Are we using water too fast? Have we developed too many uses for this water? Will the Columbia become an exhausted resource?

Lesson Activities

I. Concepts, Phrases, Words, and Numbers

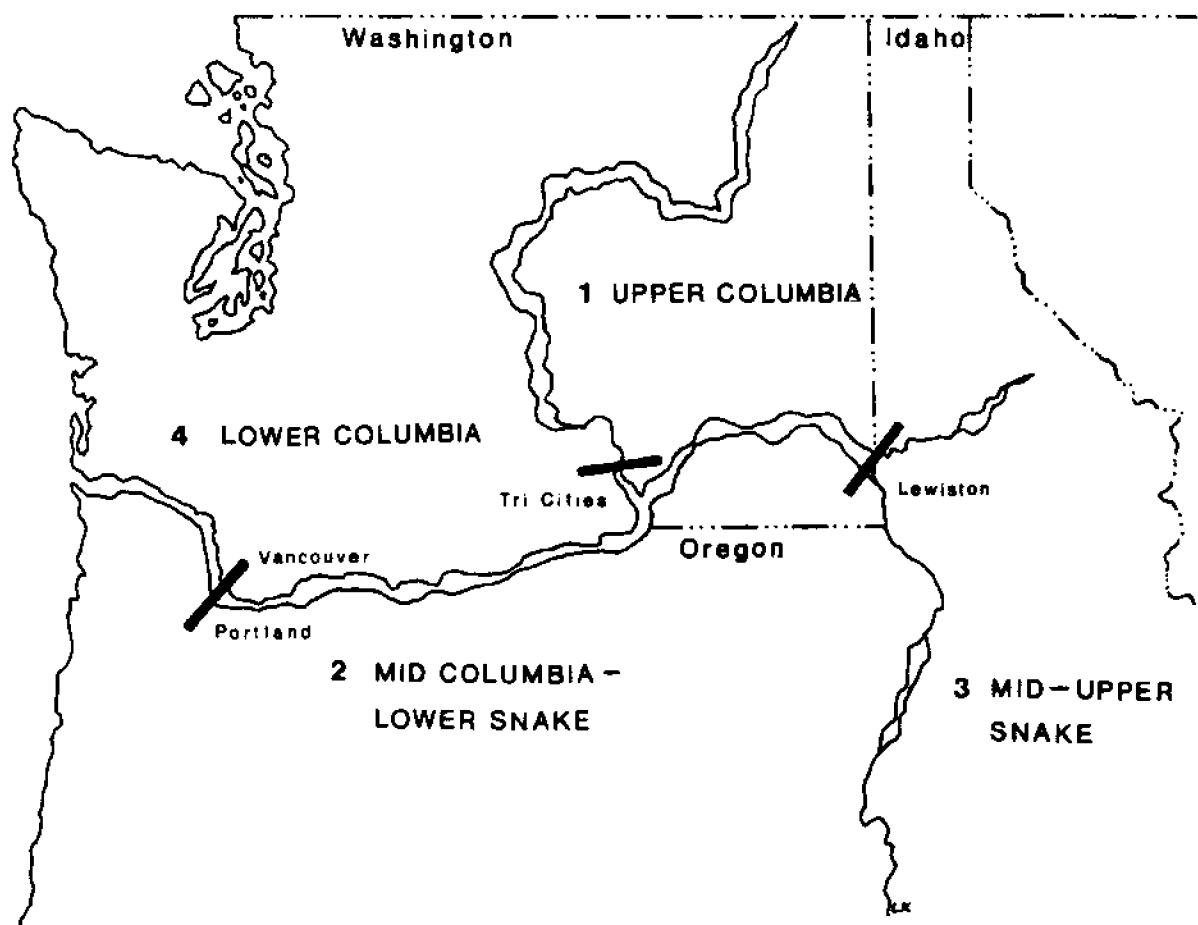
Define the following:

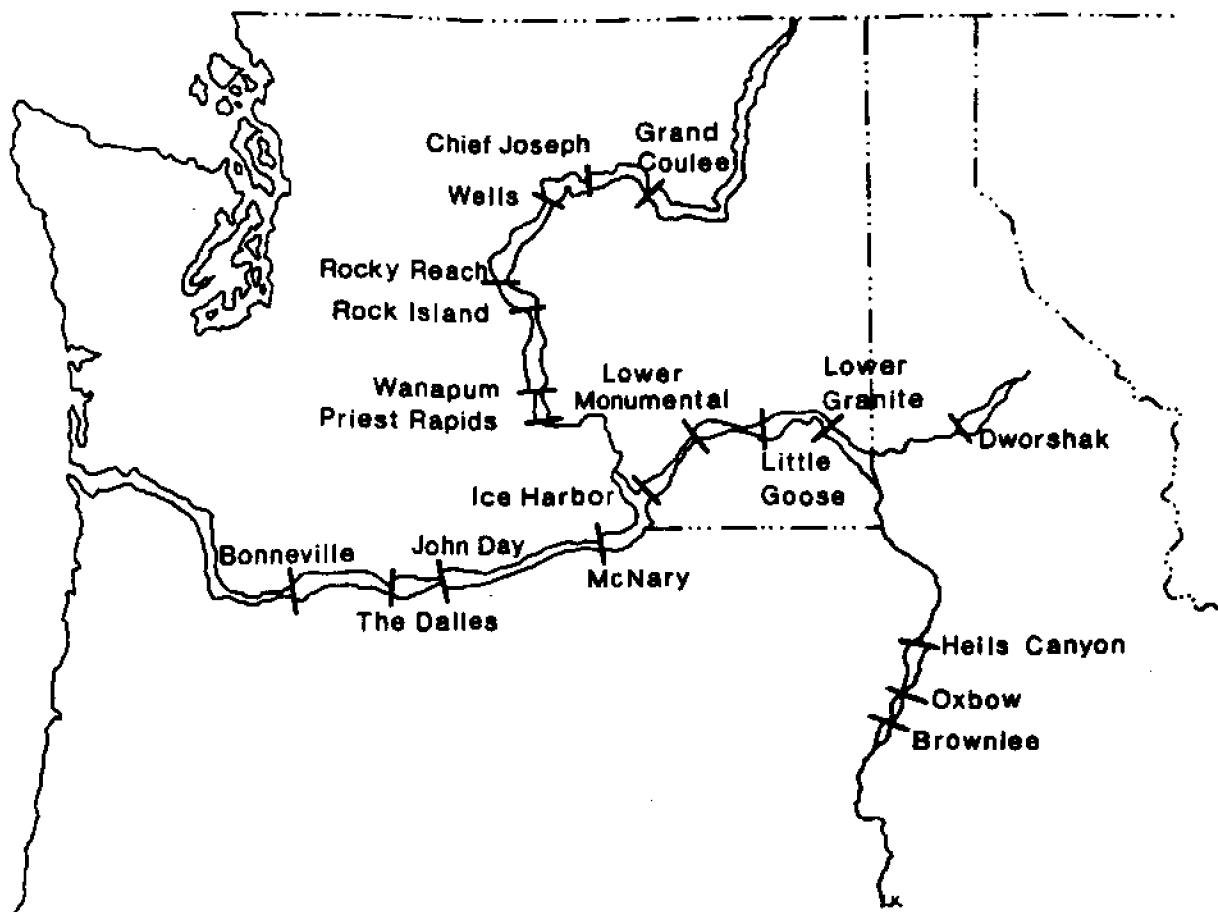
1. elevation
2. enormous
3. estimate
4. demonstrate
5. cubic mile
6. navigation
7. irrigation
8. Great Depression
9. habitat
10. inundated
11. trade-offs

II. Class Activities

1. On a map, recreate the great flood. Locate regions on the map where the ice dams were located. Trace the flood waters down the Columbia. What cities that now exist would have been under water?
2. Compare the two maps on the next pages: The Four Columbia-Snake Zones and the Major Hydroelectric Dams on the Lower Columbia and Snake. In which of the following zones are the dams located?
 - a. upper Columbia
 - b. mid-Columbia and lower Snake
 - c. mid- and upper Snake
 - d. lower Columbia
3. Discuss the great floods. Compare this great geological happening with present-day earthquakes and floods.

4 SNAKE-COLUMBIA RIVER ZONES





Major Hydroelectric Dams on Lower Columbia and Snake

Dam	Operator	River Miles To Columbia River Bar	Present Capacity	Planned Total Capacity
Bonneville	Army Corps of Engrs.	145 mi.	518,400 KW	1,078,400 KW
The Dalles	Army Corps of Engrs.	192 mi.	1,807,000 KW	1,807,000 KW
John Day	Army Corps of Engrs.	218 mi.	2,160,000 KW	2,700,000 KW
McNary	Army Corps of Engrs.	292 mi.	980,000 KW	2,030,000 KW
Priest Rapids	Grant Co. P.U.D.	397 mi.	774,000 KW	1,138,000 KW
Wanapum	Grant Co. P.U.D.	418 mi.	831,000 KW	1,225,000 KW
Rock Island	Chelan Co. P.U.D.	453 mi.	403,000 KW	NA
Rocky Reach	Chelan Co. P.U.D.	468 mi.	1,213,000 KW	NA
Wells	Douglas Co. P.U.D.	518 mi.	788,000 KW	NA
Chief Joseph	Water & Power Resources Service	545 mi.	1,689,000 KW	2,069,000 KW
Grand Coulee	Army Corps of Engrs.	597 mi.	6,195,000 KW	10,000,000 KW
Ice Harbor	Army Corps of Engrs.	334 mi.	603,000 KW	603,000 KW
Lower Monumental	Army Corps of Engrs.	386 mi.	810,000 KW	810,000 KW
Little Goose	Army Corps of Engrs.	395 mi.	810,000 KW	810,000 KW
Lower Granite	Army Corps of Engrs.	432 mi.	810,000 KW	810,000 KW
Dworshak	Army Corps of Engrs.	506 mi.	660,000 KW	1,060,000 KW
Hells Canyon	Idaho Power Co.	571 mi.	450,000 KW	580,500 KW
Oxbow	Idaho Power Co.	597 mi.	220,000 KW	265,500 KW
Brownlee	Idaho Power Co.	609 mi.	450,000 KW	NA

Sources: U.S. Army Corps of Engineers, Pacific Northwest River Basins Commission, Power Planning Committee, 1979, Bonneville Power Administration.

NA—Not Available

4. Sam Barlow, after traveling the Oregon Trail, decided to construct a "road" around the southern slope of Mt. Hood so that emigrants could get to the Willamette Valley without risking the great cascades. His work was exhausting and dangerous, and the resulting road was terrible. However, many families decided to take the road instead of the water route. Barlow charged them a toll to use the road. Read more about the Barlow Road. Compare his route with that of the river.

Imagine yourself a pioneer facing the great cascade rapids after many months on the Oregon Trail. Would you have made a raft and attempted the run down the river, or would you have looked for a trail around Mt. Hood?

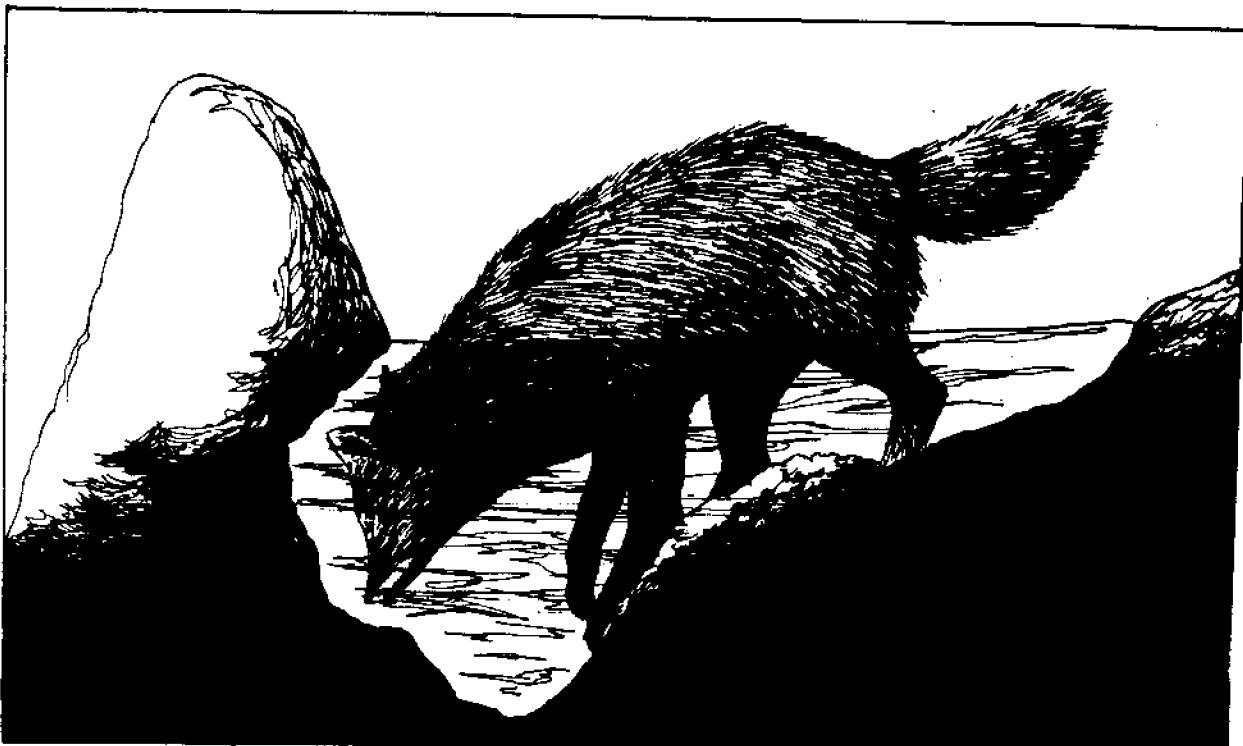
5. A legend is a special type of story. Legends were used by the Indians to explain their natural surroundings or environment. The word "legend" comes from the Latin legendus, which means to be read. But the Indians did not write out their legends. Instead, they passed them on to others in several interesting ways. They told their legends as stories around the fire. Sometimes legends were acted out in dances. Legends were also told through songs. The Indians of the Columbia also painted pictures of their legends. They made petroglyphs, or rock carvings, to share their legends with others.

Read "Coyote Takes Water from the Frog People." Decide if you agree with Coyote or the Frog People. Give reasons for your choice. Would this legend apply to today's dams on the Columbia? Why or why not?

6. Read the Indian legend "Guardians of the Columbia."
 - a. Find on a map each of the three mountains: Mt. Hood, Mt. St. Helens, and Mt. Adams. Which one is on the south side of the Columbia? Which are/is in Washington? In Oregon?
 - b. Working either alone or in groups, invent a legend to explain how one set of cities was created and named:
1) Lewiston and Clarkston; 2) Pasco, Kennewick, Richland;
3) Hood River and White Salmon; 4) Portland and Vancouver; 5) Longview, Kelso, Rainier.
7. Invent a legend to explain one of the following:
 - a. the great floods
 - b. the Columbia River Gorge and High Mountains guarding it
 - c. the landslide 700 years ago that created the "great cascades"
 - d. the sea receiving the waters of the great floods
 - e. the "hanging rivers" of the Columbia Gorge

Write up your legend and present it either in writing or orally. In inventing your legend, use any of the preceding material you have studied that will be helpful.

Coyote Takes Water From the Frog People



Coyote was out hunting when he found a dead deer. One of the deer's rib bones looked just like a big dentalia shell. Coyote picked it up and took it with him to see the Frog People. The Frog People had all the water. When anyone wanted any water to drink, to cook with, or to wash with, he or she had to get it from the Frog People.

Coyote said, "Hey, Frog People, I have a big dentalia shell. I want a big drink of water, and I want to drink it for a long time." "Give us that shell," said the Frog People, "and you can drink all you want." Coyote gave them the shell and began drinking. The water that Coyote drank was behind a large dam.

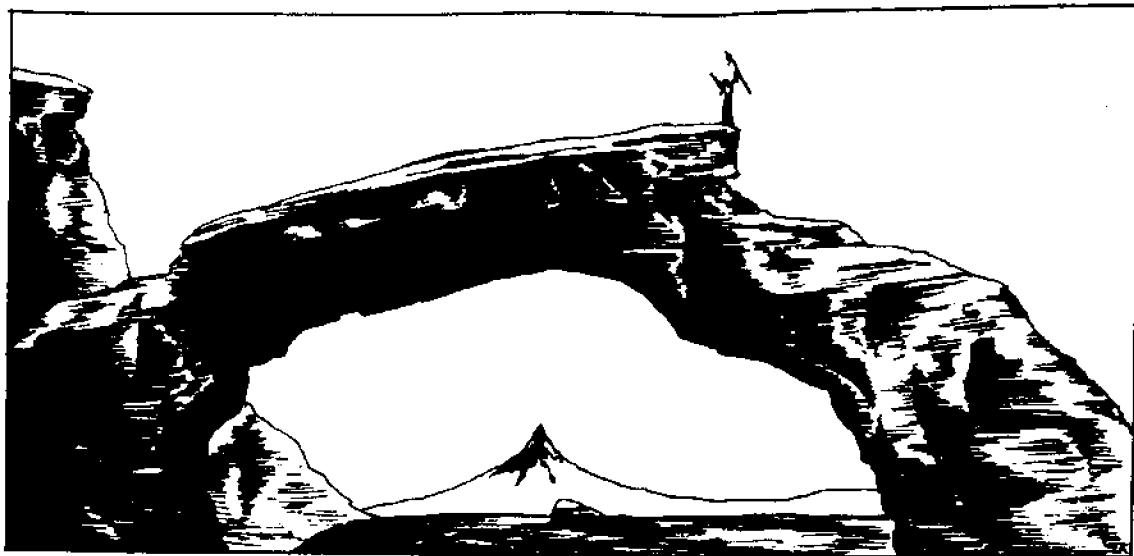
Coyote began drinking. He drank for a long time. Finally, one of the Frog People said, "Hey, Coyote, you sure are drinking a lot of water there. What are you doing that for?" Coyote brought his head up out of the water. "I'm thirsty."

After a while one of the Frog People said, "Coyote, you sure are drinking a lot of water. Maybe you had better give us another shell." "Just let me finish this drink," said Coyote, putting his head back under the water. The Frog People wondered how Coyote could drink so much water. They thought Coyote might be trying to trick them.

All the time he had his head underwater, Coyote was digging out under the dam. When he was finished, he stood up and said, "That was a good drink. That was just what I needed." Then the dam collapsed and the water went out into the valley and made the creeks and rivers and waterfalls. The Frog People were very angry. "You have taken all the water, Coyote!" Coyote said, "It is not right that one people have all the water. Now it is where everyone can have it."

Now, anyone can go down to the river and swim or get water to drink or to cook with.

Guardians of the Columbia*



The old men of the tribes say it was Tyhee Saghalie, chief of all the gods, who put the Guardians of the Columbia there, and they say it was an act of harsh justice tempered by the melancholy of a tired old man whose sons took up arms against each other.

They say Tyhee Saghalie and his two hot-tempered sons came down the river from the far north in search of a land suitable for the Tyhee of all gods, and after a long, arduous trip that was difficult even for a god, they found the land beside the river where the rocks were like stepping stones, which the white men named The Dalles.

They had never seen a land so beautiful, and Tyhee Saghalie made it his own. But his two sons quarreled over the possession of that land, and Tyhee Saghalie settled the dispute by shooting two arrows from his powerful bow--one to the west and one to the north. One son, Klickitat, followed the arrow to the north and made it his land and became the grandfather of a tribe named for himself. The other son, Wy-east, followed the arrow to the west and became grandfather of the Multnomahs, who lived beside the river called Willamette.

*There are many legends about the Bridge of the Gods. This land bridge was claimed to span the Columbia River near present-day Cascade Locks, Oregon. Various Indian tribes living in the Gorge had their own version. This version comes from the Klickitat Indians.

Then Tyhee Saghalie raised the mountains on both sides of the river for a boundary between the sons' land, but he did not raise any high enough to have a cap of snow, perhaps remembering the cold of the far north. Then he built the most beautiful structure man had ever seen--Tahmahnawis, the Bridge of the Gods--so that his sons and their children might pass across the river in safety and that his family might not always be divided.

Then Tyhee Saghalie did a good thing that led to the destruction of his family. On the river lived a witchwoman, Loowit, who was the ugliest of the ugly crones. But being a woman, Loowit had a way to make herself needed and wanted: she had charge of the only fire in the world.

She saw how miserable the tribes on both sides of the river were during the long, wet winters with no fire to keep them warm or to cook their fish and venison. It hurt Loowit's heart to see the women always cold and wet and to see the little children sick and dying.

So one day she made a gift of the fire to Tyhee Saghalie. His gratitude was without limit, and he offered Loowit anything she wanted.

She asked what any ugly woman would ask and she became the most beautiful maiden in the world. All the young men fell in love with her, but she paid them no attention.

Then she met Tyhee's sons, Klickitat and Wy-east. She could not decide which to marry, and their tribes quarreled among themselves over which of their chiefs should have Loowit's hand. Soon war broke out between the brothers' people.

Tyhee Saghalie was sad and angry. He knew that to end the fighting he must destroy the cause. First he destroyed the Bridge of the Gods. Then he put Loowit, Wy-east, and Klickitat to death.

But he felt responsible for the tragedy, and he loved all three he had put to death. Because they were beautiful in life, he wanted them to be admired forever.

He made Wy-east into Mt. Hood, Klickitat into Mt. Adams, and Loowit into Mt. St. Helens.

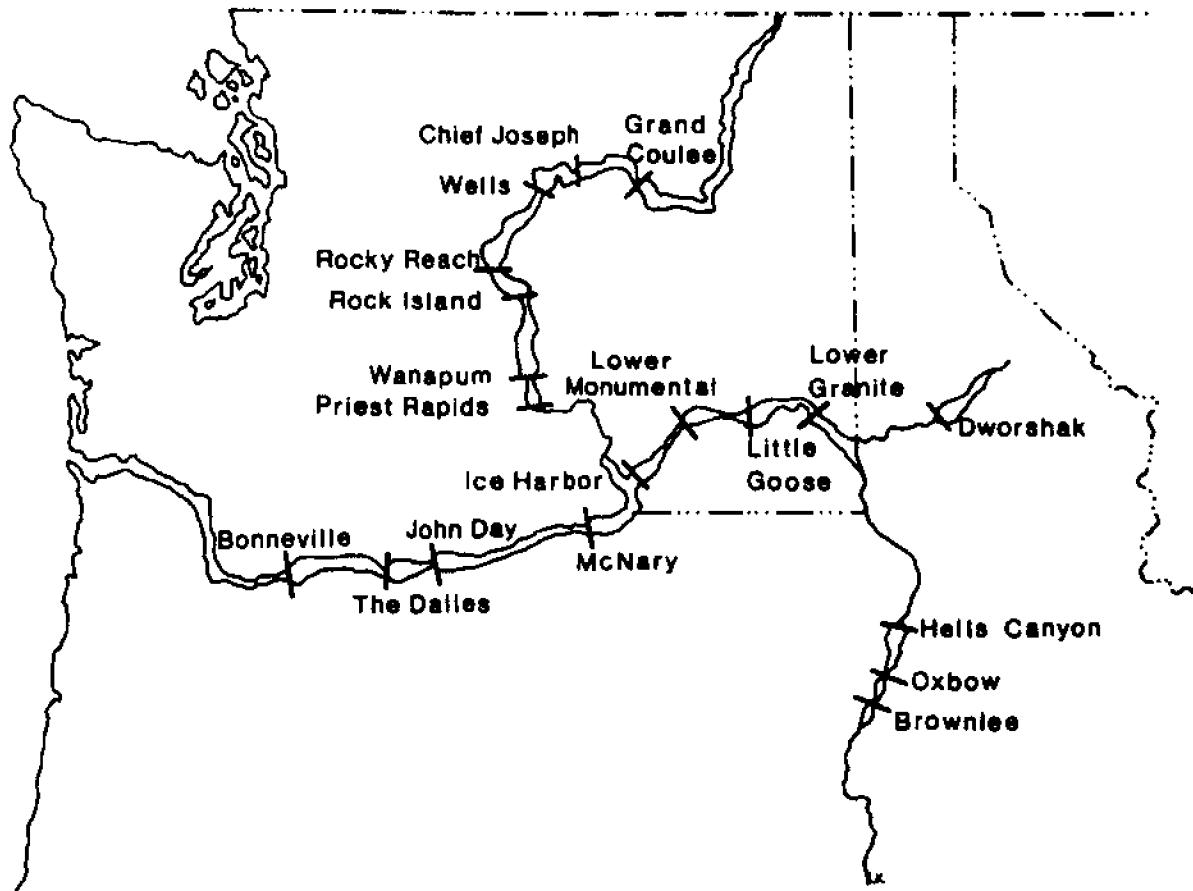
And the rocks from the Bridge of the Gods that fell into the river created the great Cascades.

From Archie Satterfield's Moods of the Columbia (Seattle: Superior Press, 1968).



Energy

Power: A Reading



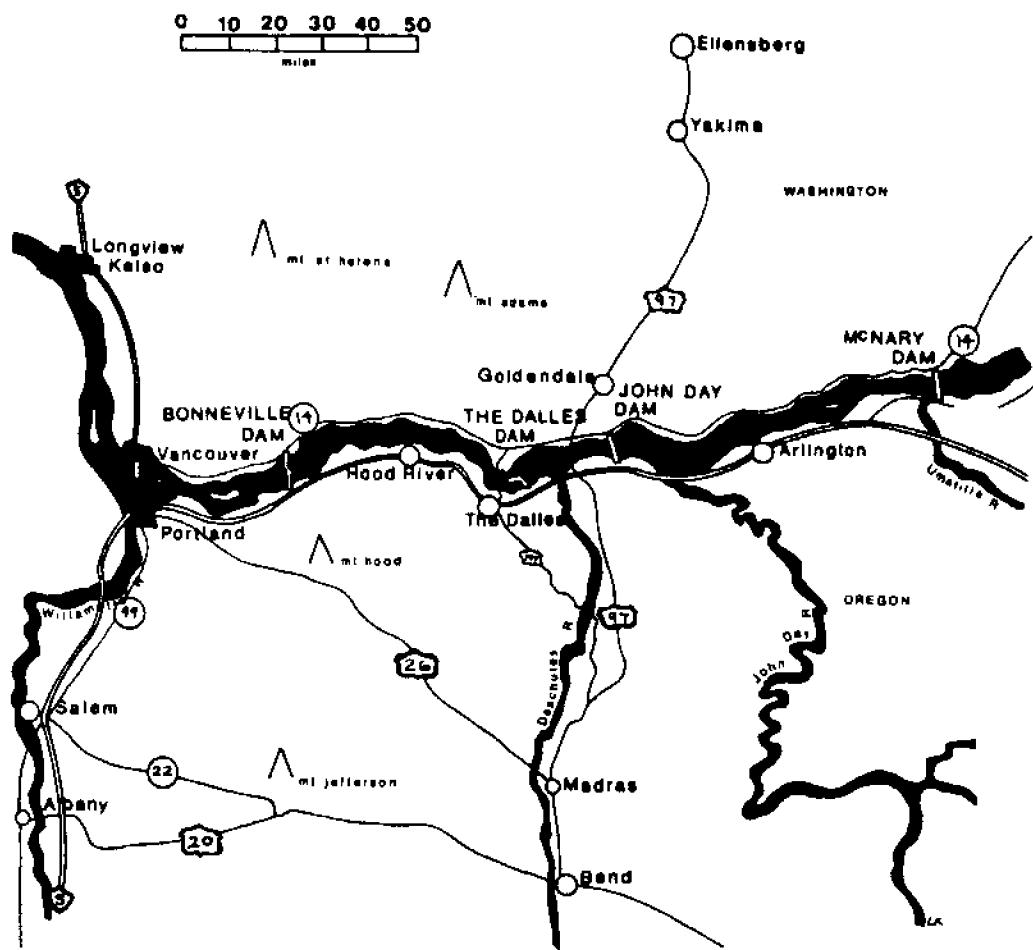
Major Hydroelectric Dams on Lower Columbia and Snake

The Columbia River and its tributaries are impounded more than 190 times by dams constructed for electrical power, recreation, flood control, and transportation. The Columbia system has 38 major hydroelectric projects located on its mainstream. The system not only supplies the Pacific Northwest with most of its energy needs, but it also accounts for more than half of the hydroelectric generating capacity in the whole United States.

Every time you flick on your stereo or TV set, a power generator somewhere in the Pacific Northwest goes to work for you. Water pouring through huge generators inside a Columbia River dam may be producing electrical power that allows you to enjoy your stereo or TV. On the other hand, every time you listen or watch, there may be less water available for fish migration, navigation, watering of crops, or

swimming in the river. Again, the constant concern is for trade-offs. If you want more electrical power, you may have to give up something else. Soon, according to estimates, it will be possible to use every drop of water in the Columbia River system to turn hydroelectric turbines generating electricity to meet our energy needs and wants. This means that every gallon of water used for fish passage around the dams, for locks that allow tugboats, barges, and recreation boats to get by the dams, and for diverting water from the river so that crops can grow amounts to a loss of potential electrical energy.

Most of us want the river, the fish, our swimming holes, good food, scenic beauty, and our stereos and TVs. Today, some of us have it all. That won't last.



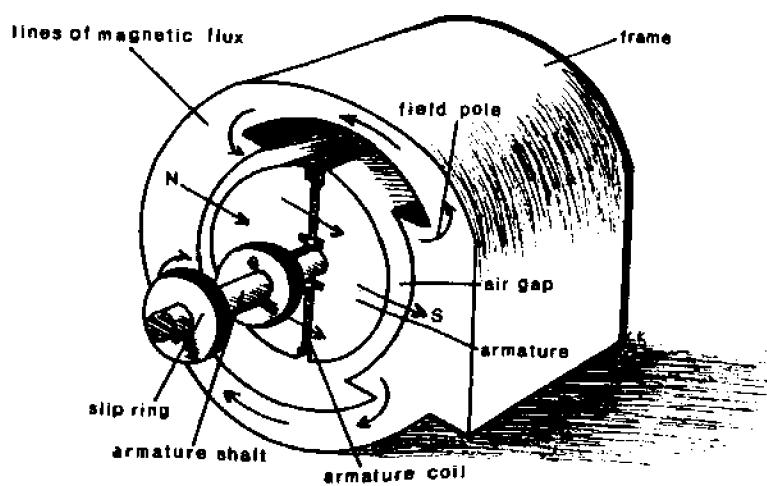
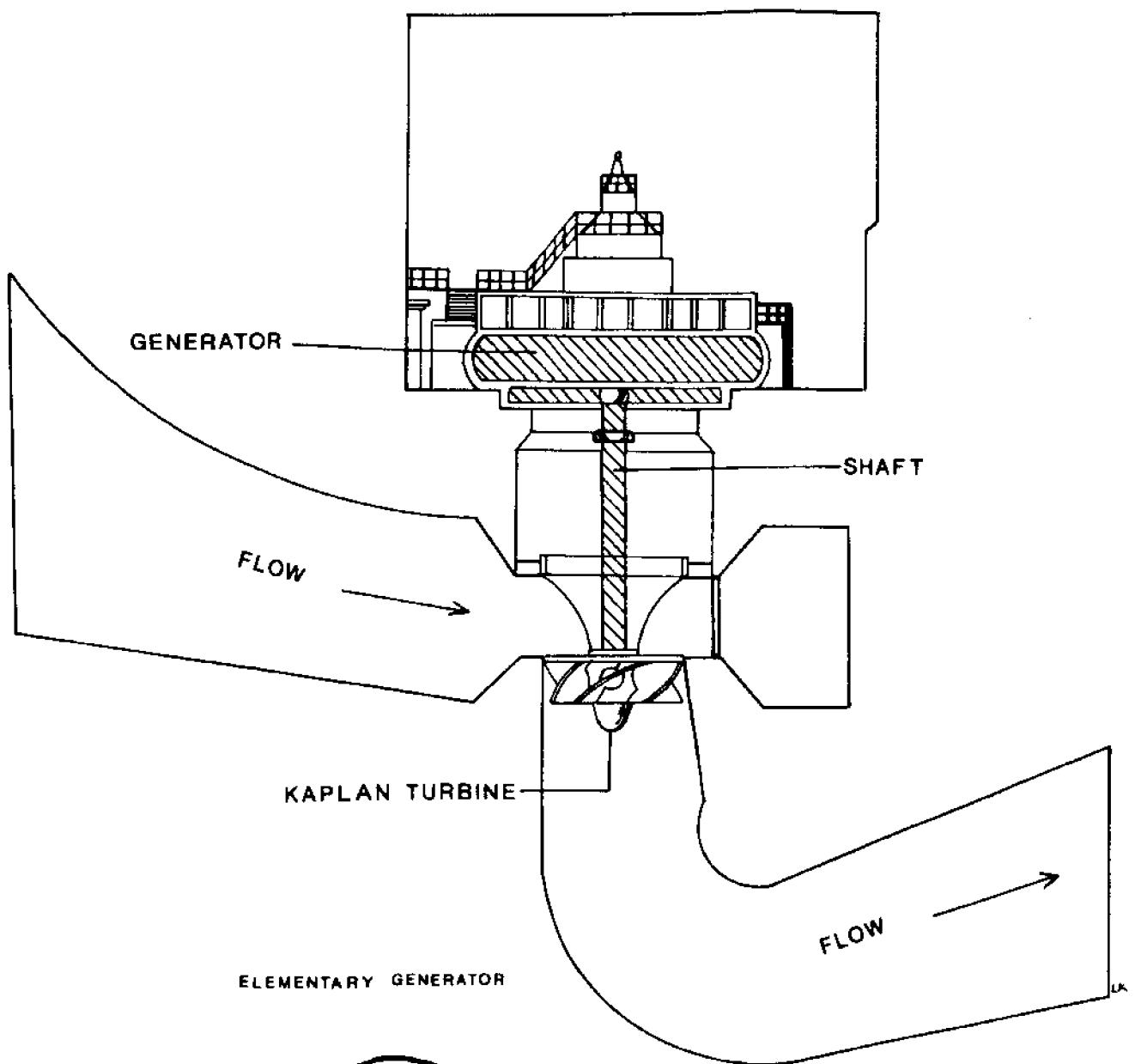
The Dalles Dam that stretches between Washington and Oregon near the highway that connects Washington with Oregon and California is one of those huge dams on the Columbia. It generates electrical power, has a navigation lock, and also contains fish passage facilities. The dam also created a high lake behind it. Boaters love the lake, but the wildlife populations that formerly lived on the shores of the river died or were displaced. They lost their homes. Many Indians also left their homes and the site of the sacred fishing grounds (Celilo Falls).

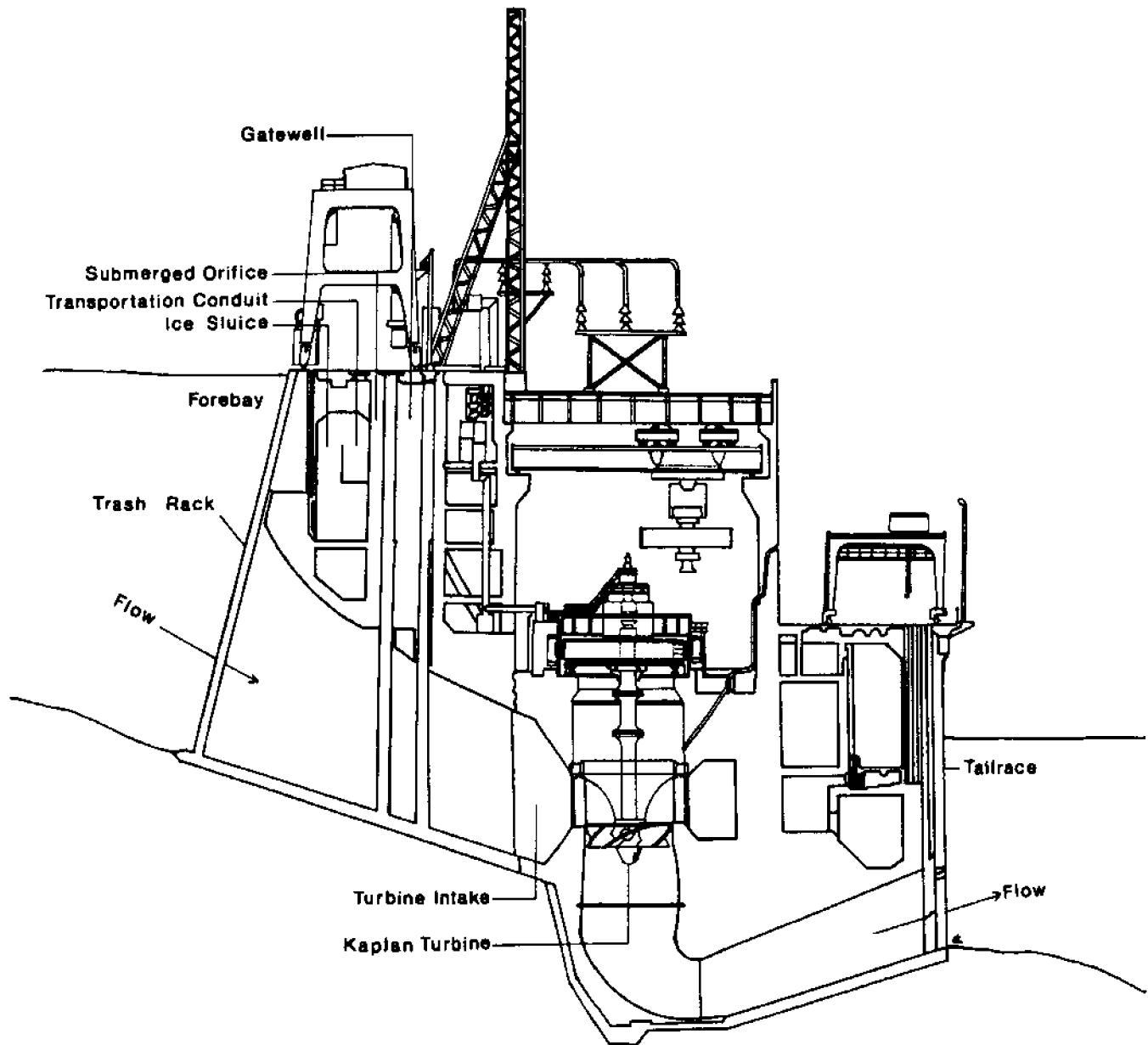
The dam was built in 1957 and can generate enough electrical energy to meet the energy needs of two cities the size of Seattle. That is an enormous amount of kilowatt hours. The Dalles Dam is only one of many. It seems impossible that we could be running short of power in the near future, but it is possible.

If you drive on the highways along the Columbia, you may see large wheels connected by pipes pumping many gallons of water onto green fields. These crops are used as food for both humans and cattle. Think about this the next time you eat a hamburger. If these irrigation pipes were not there, most of those fields would be dry and brown and, of course, would produce very little grain. In fact, 90 percent of all the water that is diverted from the Columbia goes to crop irrigation. Farmers like the dams. Farmers and commercial fishermen can get into serious arguments over them, however, for in spite of the fish passage facilities, many young salmon do not make it downstream to enter the sea, and many adult salmon do not make it past the dams to enter the stream of their birth to spawn and produce more young salmon.

Not only are many of the salmon and steelhead destroyed after being sucked through a dam's machinery; many become disoriented by the lakes of the Columbia that were created by the dams. Today, the Columbia is no longer a fast-flowing river. When an environment is changed, the life it once supported changes. Many fewer salmon and steelhead now live in the river, and, of those that do, it is estimated that 5 to 15 percent of the young fish may be killed at each dam. The odds are very slim that a young fish from a mountain stream entering either the Snake or the upper Columbia will make it to sea, reach adulthood, and make it back to spawn. We may have our grain, but the opportunity of having fish with it is decreasing.

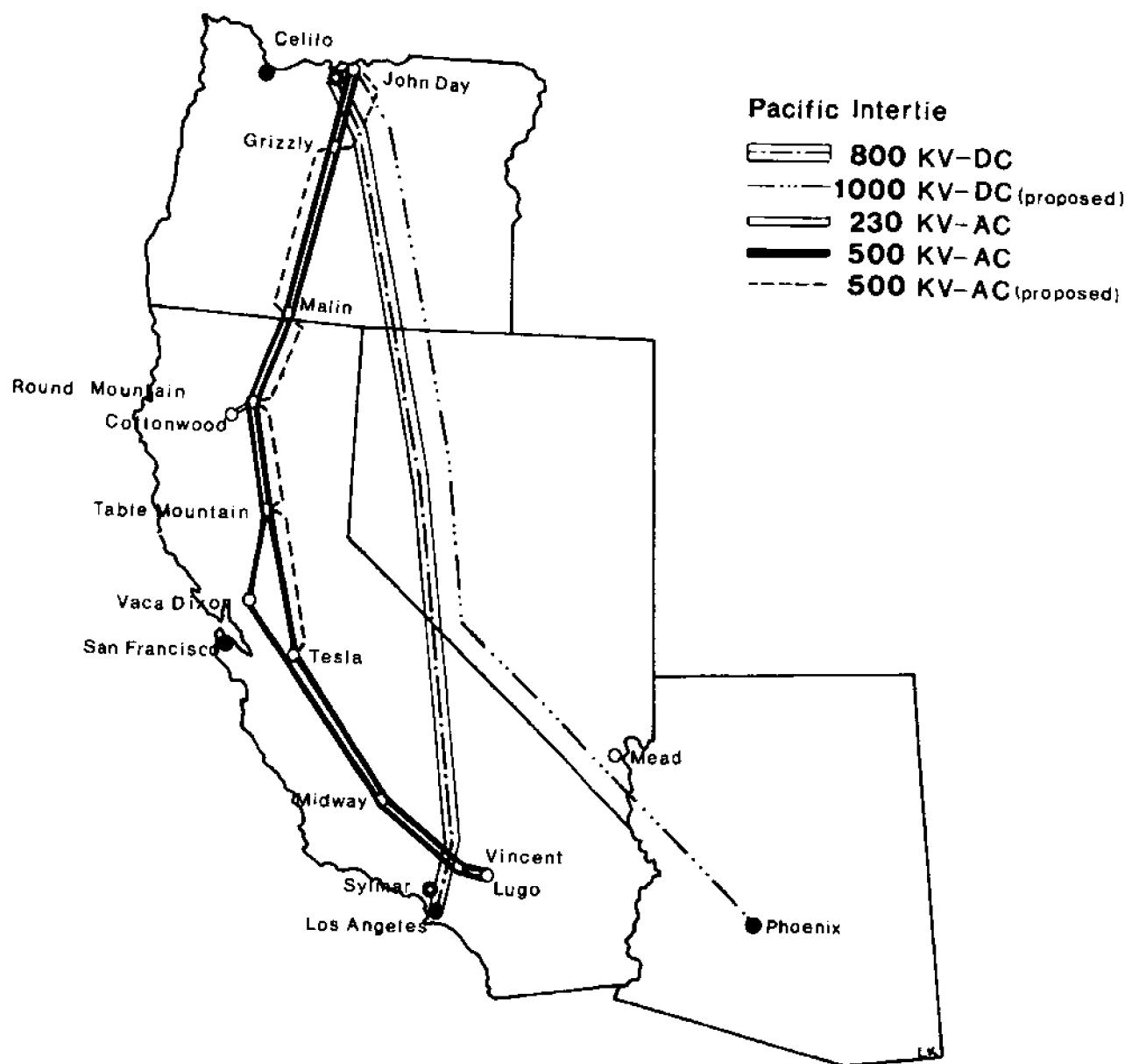
Also, in the future these dams may be used to generate "peak power" in the region. We tend to use electricity in spurts; a peak period (high demand) is early in the morning when we get ready for school or work; or in late afternoon when we come home. The dams are one way of helping meet this sporadic demand. Holding water back behind the dam is essentially storing electricity. During these peak periods, water will be released through the turbines to produce electricity. However, using the dams for "peaking power" may produce extreme water fluctuations which could have serious effects on rivers, fish, wildlife, recreation, navigation, waste assimilation, and aesthetic value. Again, the issue is trade-offs; how do we balance use among the competing users of the water?





Cutaway View of a Dam

POWER TRANSMISSION



Lesson Activities

I. Concepts, Phrases, Words, and Numbers to be Demystified

Define the following:

1. impounded
2. hydroelectric generating capacity
3. diversion
4. turbine
5. kilowatt
6. peaking power

II. Class Activities

1. Complete the word assignment, "How is Water Turned Into Electricity?" To aid you in your task, study the diagram of a dam first.

Each of you fill in the words you know. After all of you have completed the task, compare copies and help each other fill in missing words. Then read it again, making sure the words fit and make sense.

Discuss the reading, especially taking care with the questions at the end. For example, if a student leaves a 100 watt bulb on in a bedroom for 24 hours, how long would it take to consume a kilowatt?

Homework: you could ask your parents answers to the last four questions of the word assignment and compare answers in class.

Before finishing this assignment, make sure you understand the basic mechanics of how a hydroelectric dam operates.

How is Water Power Turned Into Electricity?

Description of Activity

To discover how water is turned into electricity, fill in the blanks in the essay. For every blank, there is only one word or phrase (listed in the columns after the essay).

Many dams on the Columbia River were built by the _____. The dam has two separate parts: a _____, which produces electricity, and a _____, which does not produce electricity, but does help to regulate the water level.

_____ is the type of electricity produced at this dam. _____ means water! The water on the upstream or _____ side is blocked by the dam and is higher than the water on the downstream or _____ side of the dam. When water flows down through the dam, it causes giant propellers, called _____, to spin. These are attached to machines which spin and produce electricity, measured as _____. The rotating part of these machines, known as _____, is a huge electromagnet. The stationary part, known as a _____, is made up of coils of copper wire. When the coils of copper wire are passed by the magnetic field, tiny particles known as _____ move. This movement is known as an electric current!

Next, the electricity flows through a _____, which transforms the electricity into higher voltage electricity. High voltage electricity travels more efficiently through lines than does low voltage electricity. When the electricity leaves the dam through the lines, it becomes the property of the _____, a different federal agency which sells the electricity to your power company. When the high voltage electricity gets to your neighborhood, it is transformed again into low voltage electricity so you can use it in your home.

To give you an idea of how much electricity you use compared to how much is produced at a dam, here is something you can do. If you had ten 100 watt light bulbs turned on in your home but used no other electricity, you would be using 1,000 watts, or one _____. Bonneville Dam can generate about one million, one hundred thousand (1,100,000) of these, or one billion, one hundred million watts (1,100,000,000)! That may seem like a lot of power but that does not mean you should waste any of it! Every time you use 1,000 watts for one hour you use 1 kilowatt/hour of electricity. The power company charges you a certain amount of money for every one of these that you use. How much does your power company charge? How much did you use last month? How much did it cost? How could you use less and save some money?

Use These Words to Help You to Fill in the Blank Spaces

electrons	rotor
transformer	tailrace
kilowatt	generators
hydro	powerhouse
spillway	stator
forebay	hydroelectricity
transmission	Corps of Engineers
turbine	Bonneville Power Administration

Definitions and Answers for
"How is Water Power Turned Into Electricity?

Corps of Engineers	- Governmental agency responsible for maintenance and operation of federal dams within the Columbia River system
Powerhouse	- Building and machinery for the production of electricity
Spillway	- Channel or structure which regulates reservoir overflow (water levels)
Hydroelectricity	- Type of electricity produced by dams
Hydro	- Latin for water
Forebay	- Upstream side of a dam
Tailrace	- Downstream side of a dam
Turbines	- Machinery, consisting of blades arrayed around the circumference of a cylinder, which convert the kinetic energy of a moving fluid (water) into mechanical energy
Generator	- A machine which converts mechanical energy into electrical energy
Rotor	- Rotating part of an electrical or mechanical device
Stator	- The stationary part of a motor, dynamo, or turbine about which a rotor turns
Electrons	- Subatomic particles of matter which make up electricity
Transformer	- Device which is used to transfer electric energy capable of changing its voltage, current, or phase
Transmission	- Process of sending modulated electrical waves
Bonneville Power Administration	- Federal agency responsible for marketing and selling electricity generated from federal dams within the Columbia River system
Kilowatt	- One thousand watts. A watt is a universally recognized unit of energy.

IV. Class Discussion or Written Assignment

1. Discuss in class the following questions:
 - a. What are some of the many ways of consuming electrical energy?
 - b. Which of them are most important to members of the class?
 - c. Which could we do without and not suffer major changes in our way of life?
2. Take sides on which use of electrical power is most important. Prepare a careful argument for your side's use being most important.

Compare your arguments and see if the class agrees afterward that one or two uses are indeed most important.

The sides: Television and radio

City streetlights and lighting up buildings at night

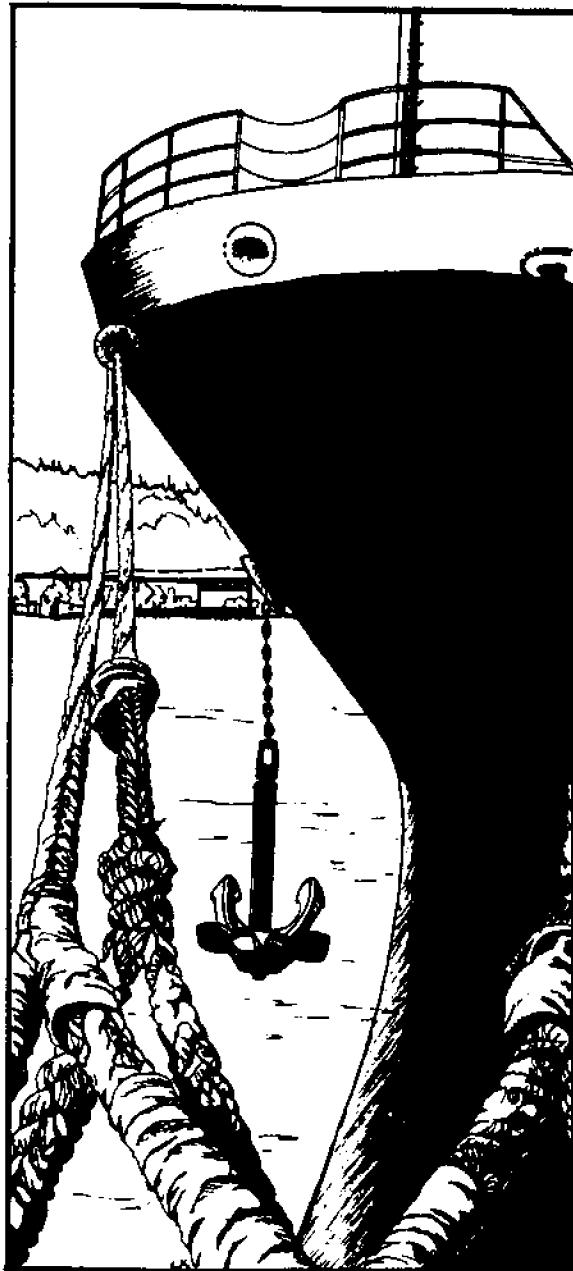
Telephones and computers

Home consumption: dishwasher, refrigerator, laundry, and so on, excluding TV, radio, and the telephone

Operating the electrical needs of businesses and industries

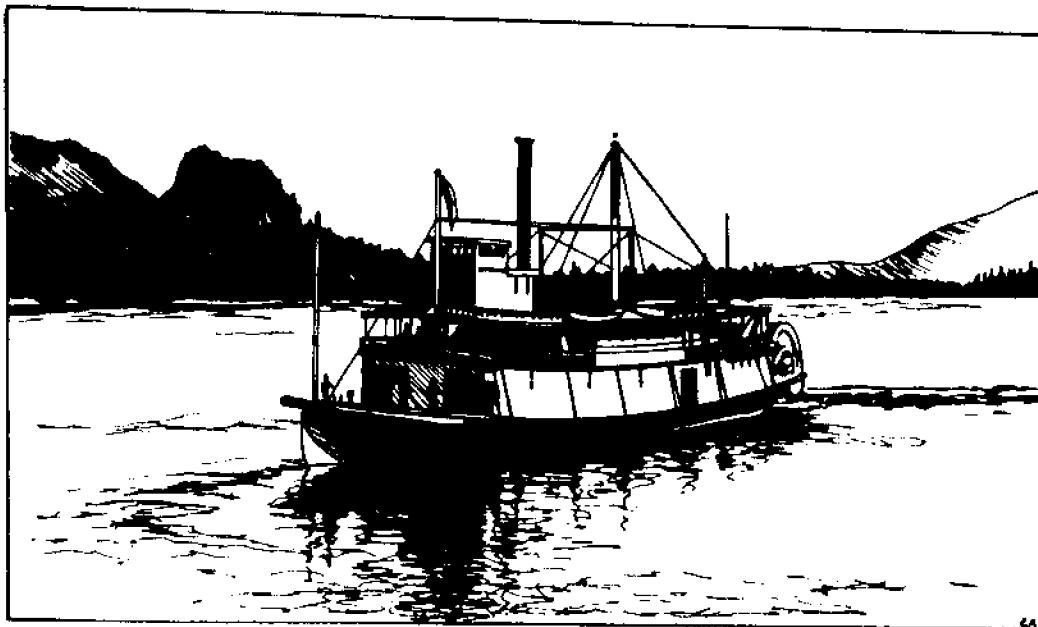
Keep in mind that emergency services such as hospital use are not included. Your argument and class discussion should focus only on the five uses listed above. How can you conserve your use of electricity so we will have enough energy to meet future needs?

3. Study the energy grid map. Learn the vast area supplied by Columbia River water power.
4. If possible, visit one of the dams in your area. Most of these dams are operated by the U.S. Army Corps of Engineers or the Bureau of Reclamation. These agencies conduct interesting and informative tours and supply handout materials.



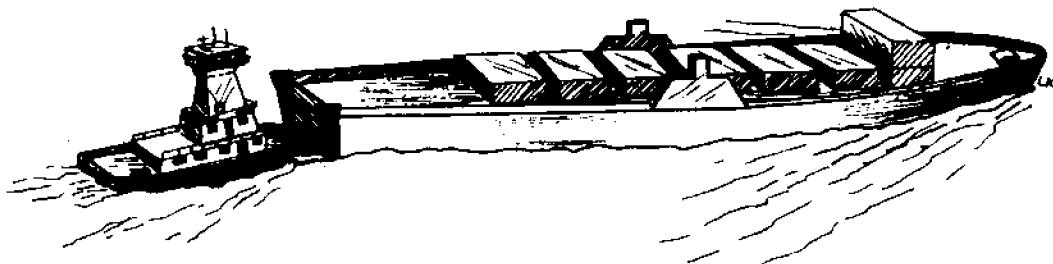
Navigation

Navigation: A Reading



Sternwheeler

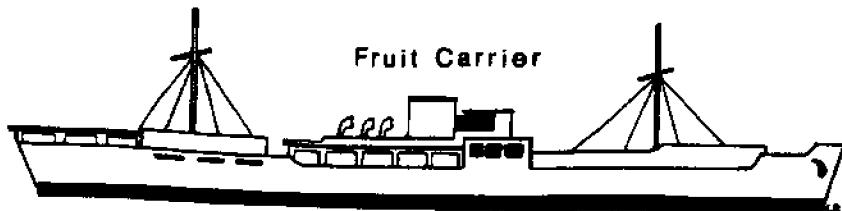
Commercial navigation on the Columbia dates back to the 19th century when sternwheelers moved goods and people along its watercourse challenged the untamed rapids. Today, a modern inland water transportation system consisting of eight locks allows commercial vessels to travel as far east as Lewiston, Idaho, some 465 miles from the Pacific. This corridor, averaging a minimum of 14 feet in depth, is one of the deepest navigation systems in the United States. Barges with a capacity of more than 3,000 tons can be accommodated on the river, compared to a 1,500-ton capacity on the Mississippi system.



Tug and Barge

Take a look at a world map or a globe. With your finger trace a line from the mouth of the Columbia at Astoria north along the west coast of Canada along the Alaskan coast and west across the Aleutian

Islands. Then turn south to Japan, Korea, Taiwan, China, The Philippines, Indonesia, New Zealand, and Australia. That would be a long walk, but this "Pacific Rim" is the main market for products grown and manufactured along the Columbia-Snake system. Lewiston, Idaho, is only a barge trip away from Portland and then an ocean vessel trip away from these Pacific Rim countries. As you read before, grain and other products loaded on barges at Lewiston and Pasco come not only from eastern Washington, eastern Oregon, and Idaho, but from the Midwestern United States as well.

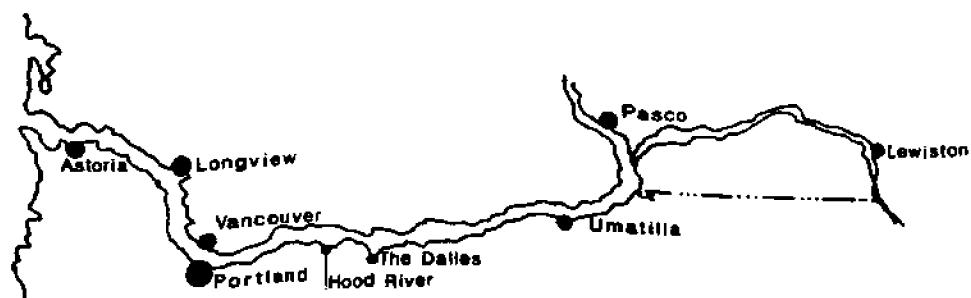


We are all familiar with imported cars, TV sets, and radios from Japan. Many of these goods come upriver to the major ports along the Columbia, such as Astoria, Longview, Vancouver, and Portland. Downriver the products include varieties of grain and timber. They go down in shallow-draft barges to the deep-draft ports and then are loaded on ocean-going vessels for markets around the world, especially the Pacific Rim markets. Without the Columbia and Snake river navigation, many businesses and industries that distribute imports to us and sell exports would locate somewhere else. Jobs would go with them, and many of us would live away from the Columbia.

Jobs associated with navigation can be found all along the Columbia. For example, workers load grain on barges in the ports of Lewiston, Umatilla, and Pasco. At ports such as Portland, Vancouver, Kalama, or Longview, dock workers load it on ocean ships.

For imports, the process is reversed. Workers may unload cars and other finished goods at Portland and Vancouver and send them to many cities in the United States. You can find a variety of activities centered around these ports.

MAJOR PORTS



Astoria, the first port of entry on the river, was established in 1811 by John Jacob Astor. Lewis and Clark spent the rainy winter of 1805-06 near here at Fort Clatsop. The city has long been a center of fishing and canning. Today the principal export from Astoria is timber. The port is located only 10 miles from the ocean, and large ships come and go. From Astoria it is 540 nautical miles to San Francisco, 260 nautical miles to Seattle, and 100 miles to Portland. It's a handy place for a port. It is also close to the vast timber industry of the coast range in northwest Oregon and southwest Washington.

The Port of Longview, Washington, is 66 miles from the Pacific Ocean and is third in size of all Washington ports. It is a center of barge and railroad traffic and only three miles from Interstate 5, the main highway from Vancouver, British Columbia, to San Diego, California. This port, too, is in a good location. Small farms in southwestern Washington and the timber industry are near Longview. Port Longview has the largest water-based crane on the West Coast (nicknamed "The Columbia Giant"), and has space for seven ships to dock.

Vancouver, Washington, across the river from Portland, is a larger city than either Astoria or Longview and, like Portland, is the end of the line for deep-water ocean ships and the beginning of barge traffic on the Columbia. Therefore, many products and materials are changed here from one type vessel to another. As at Longview, many ships can dock there. Grain is a major commodity that is changed from one vessel to another. Vancouver is located near Interstate 5, which, as in the case of Longview, gives it highway access to most of the West Coast.

Portland is the largest port on the Columbia, and the third largest on the West Coast. It is 110 miles from the ocean. It is by far the largest city of all the Columbia River ports and has extensive commercial, banking, business, and industrial locations. It too is on Interstate 5. It is a major railroad center and is the leader on the entire West Coast of grain exportation and auto importation. Many shipments to states in the Midwest and East take place in Portland. Daily, ships enter and leave Portland carrying flags from many Pacific Rim nations. Like Seattle and San Francisco, Portland is a gateway to the Far East.

Portland is also the terminus for the movement of farm products up the Willamette. Therefore, it receives products not only from the east and west, but also from the south--the fertile Willamette Valley. From pioneer days, farmers have shipped their produce from the Willamette Valley to Portland for export.

The discussion above deals primarily with the major ports on the lower Columbia. Small ports such as Kalama and St. Helens have not been mentioned, but are equally important to the areas they serve by providing jobs and economic stimulus to these river communities.

As we already indicated, ports upstream of Portland and Vancouver are shallow-draft ports. Because of the construction of the eight dams on the Columbia and Snake, barges can now travel to Lewiston, Idaho. There are many small ports in this stretch of the Columbia River system. These include the ports of Cascade Locks, Hood River, The Dalles, Arlington, Morrow, and Umatilla in Oregon and the ports of Stevenson County, Klickitat County, Pasco, Benton, Kennewick, Clarkston, and Whitman County in Washington. These ports are involved in a variety of water-borne activities, ranging from transferring grain shipments to providing recreational opportunities. Each port serves an important economic role in its area.

There are some problems with this transportation network. One constraint to continued growth of the navigation system is the Bonneville Locks. Constructed in the 1930s, they constitute a bottleneck on the system, with barge traffic often backed up and delayed. A new, enlarged lock has been proposed that would make all locks on the Columbia uniform in size (86 feet by 675 feet). Proponents claim that the new lock will make the Northwest a major exporter of agricultural products. Construction will not begin until financial, environmental, and legislative issues are resolved.

Another problem is the potential for conflict between navigation and other river uses. In low-flow periods, water required to operate locks reduces power generation. On the other hand, use of the dams for peak load generation and resulting water fluctuations can endanger navigation. Here too, trade-offs must be made.

Lesson Activities

I. Concepts, Phrases, Words, and Numbers

Make certain you understand the following phrases and words:

1. Pacific Rim
2. market
3. vessel
4. import
5. export
6. river mouth
7. principal
8. nautical mile
9. commodity
10. extensive
11. gateway
12. terminus
13. dredging
14. deep-draft port
15. shallow-draft port

Find any other words or phrases in the text which you do not understand. Make sure you know what they mean before you proceed.

Read Navigation and Commerce on the Mid-Columbia/Lower Snake River System, by William A. McNamee and Lewis E. Queirolo. You will learn about the ports and navigation upriver from Portland.

II. Class Activities

1. The ports of Lewiston, Pasco, Portland, and Longview are all at a confluence of two rivers. What is a confluence? What are the rivers in the case of each port?
2. Locate on a map that you draw the ports mentioned in the above readings: Astoria, Longview, Vancouver, Portland, The Dalles, Morrow County, Umatilla, Pasco, Whitman County, Clarkston, and Lewiston.
3. On the map you drew for question 2, locate each of the eight dams on the Columbia-Snake river navigation system.

III. Class Discussion and/or Written Assignments

1. Discuss the different types of vessels which use the Columbia River navigation system. What are their similarities? Differences? What types of products do they carry? Which type would you like to pilot? Why?
2. Find in the Portland newspaper (or possibly another) the daily log of ships departing and arriving. Continue this for a week and keep count of the number of ships going each way. Also list their country of origin.
3. Locate a port near you. Find out what types of activities it is involved with. Call or write the port authorities for information. How important is this port to your community?
4. You have been appointed port director of one of the Columbia River ports mentioned in this section. Create an advertisement for radio, TV, a newspaper, or a magazine that illustrates why your port is the best port for farmers, lumber people, or importers to use in your area. Use any of the information from this section, as well as whatever research you do to make your advertisement more convincing.

After you have finished your advertisement, demonstrate it to your class and compare efforts.

5. Construction of a new lock will relieve the bottleneck on the Columbia River navigation system. However, some groups and organizations may be opposed to this huge construction project. Why do you think some environmental groups and the railroads would object to the new locks? What groups would favor the locks?

TOTAL OCEAN COMMERCE

	1981 (Short Tons)	1982 (Short Tons)
Inbound From Foreign Ports	2,156,863	1,780,605
Outbound To Foreign Ports	10,677,202	9,537,471
Totals		
Dry Cargo	12,699,702	11,248,255
Petroleum ¹	2,744,986	2,046,974
Foreign In and Out	12,834,065	11,318,076

REGISTRY OF ARRIVING VESSELS*

Flag	1981	1982
Japanese	426	442
Liberian	390	357
American	305	288
Panamanian	199	262
Republic of Korea	139	130
Greek	104	91
Norwegian	76	62
British	46	43
Indian	32	39
Danish	39	31
Swedish	29	27
Canadian	45	22
Philippine	10	21
Republic of China (Taiwan)	31	17
Dutch	16	16
Singaporean	15	16
Argentinean	6	11
Bulgarian	0	11
Russian	27	11
People's Republic of China	13	7
French	3	5
German	9	5
Indonesian	8	5
Malaysian	3	5
Australian	0	4
Irish	2	4
Belgian	0	3
Cyprian	7	3
Bahamian	0	2
Yugoslavian	3	2
Brazilian	0	1
Chilean	3	1
Colombian	0	1
Ecuadorian	0	1
Finnish	4	1
Italian	3	1
Mexican	0	1
Netherland Antilles	3	1
Nicaraguan	0	1

*Columbia River arrivals. Does not include military vessels, oceangoing tugs or American barges.

LEADING FOREIGN COMMERCE NATIONS

	Exports (Short Tons)	Imports (Short Tons)
Japan	3,485,277	536,224
Republic of Korea	1,478,030	419,731
Egypt	1,058,867	244,423
Republic of China (Taiwan)	636,829	88,427
India	608,829	62,321
Philippines	560,040	37,164
Indonesia	410,616	34,864
Malaya	258,288	26,724
Belgium	163,421	22,064
People's Republic of China	131,302	13,705

VALUE OF EXPORTS AND IMPORTS

(Ten Leading Nations)

Oregon Customs District²

(All Oregon ports plus Washington ports along the Columbia River for all modes of transportation.)

Exports

Japan	\$1,531,742,283
Republic of Korea	330,539,714
Egypt	234,867,025
Republic of China (Taiwan)	163,212,010
Philippines	159,310,043
India	119,843,166
Indonesia	108,879,227
People's Republic of China	86,767,457
Australia	79,314,630
Italy	45,538,638
1982 Total Export Value	\$3,316,017,452

Imports

Japan	\$1,562,522,367
Australia	235,598,545
Republic of Korea	154,294,445
West Germany	152,197,651
Republic of China (Taiwan)	100,411,485
Sweden	50,715,383
People's Republic of China	42,333,455
Malaysia	36,891,445
United Kingdom	32,336,461
Canada	30,626,416
1982 Total Import Value	\$2,631,661,413

PRINCIPAL FOREIGN EXPORTS HANDLED BY COLUMBIA RIVER PORTS OTHER THAN PORTLAND (1&2 BELOW)

(Astoria, Oregon, plus Kalama, Longview and Vancouver, Washington)

(1) Thirteen Leading Commodities Short Ton

Wheat	4,282,65
Logs	3,596,90
Wood chips	271,06
Lumber	230,54
Barley	207,27
Paper and newsprint	177,74
Corn	176,81
Paperboard	104,43
Beet pulp pellets	97,24
Milo	87,57
Aluminum	63,73
Wood pulp	50,02
Soda ash	38,97

(2) Thirteen Leading Foreign Commerce Nations

	Short Tons
Japan	4,701,726
Republic of Korea	934,277
Egypt	669,974
Philippines	505,596
Republic of China (Taiwan)	436,288
People's Republic of China	434,058
Indonesia	286,521
India	212,519
Malaya	118,017
Chile	84,573
Australia	80,139
Hong Kong	55,531
Bangladesh	39,414

Sources:

Except where noted, all data derived from Merchants Exchange of Portland, Oregon. "Foreign Import and Export Statistics for Portland, Oregon, Via Water," 1982 Annual Report. Includes data from Port of Portland public facilities and private operations.

¹Portland area petroleum movement statistics.

²First Interstate Bank of Oregon, N.A., International Division.

FOREIGN COMMERCE

1982

Commodity	Exports (Short Tons)	Imports (Short Tons)	Commodity	Exports (Short Tons)	Imports (Short Tons)	Commodity	Exports (Short Tons)	Imports (Short Tons)
Aluminum	7,538		Infusorial earth	122		Paints and resins	248	
Aluminum mfgs.	20		Iron and steel, NOS**	54		Palm oil	37,748	
Apples, fresh (14,776 bxs.)	369		Iron and steel casting	31		Palmyra stalks	7*	
Autos	37		Lab and technical equipment	1,393*		Paper and mfgs.	19,709*	
Autos, vans and parts	819*	293,889	Lentils	2,643*		Paper and newsprint	3,923*	
Bambooware		51*	Lignin pitch	38		Paper products	10,353	
Barley (27,134,522 bu.)	651,229		Livestock	264		Paperboard	114,282	
Basketware		104	Logs (85,019,082 ft.)	195,544*		Pears, fresh (4,909 bxs.)	123	
Beans, dried	4,456		Logs and lumber		369	Peas, dried	25,164	
Beef, chilled and frozen	4,996*		Lumber (81,639,815 ft.)	134,706		Petroleum products	22,900*	114,149*
Bentonite clay	219,033		Machinery and parts, agric.	604		Pineapple, canned		2,729
Beverages, alcoholic	1,744	5,293	Machinery and parts, lift trucks	900		Pipes, NOS**		27,012
Buckwheat	851*		Machinery and parts, lumber	1,176		Plywood	28,157	
Building materials		1,099	Machinery and parts, mining	1,152		Plywood and veneer		65
Building supplies	11,970		Machinery and parts, NOS**	3,117	18,030	Pork, frozen	275	
Buildings, precut/prefab	218		Malt	5,511*		Potatoes, dehydrated	22,152*	
Bulbs and garden seed	1,342*		Marble, granite and stone		185	Potatoes, frozen	19,401*	
Bullets and explosives	98		Meat, NOS**	103		Poultry, frozen	66	
Burlap and bags		4,639*	Merchandise, NOS**	1,495		Poultry and stock feed	2,530*	
Carbide, silicon	460		Metal, misc. iron and steel products			Prunes, dried	325	
Carbon products		713	Metal, NOS**	462		Quartzite rock	49	
Cascara bark	15		Metal scrap	183,894		Recreational equipment		422
Cement		30*	Milk, powdered	2,924*		Rope and twine		465*
Chemicals	1,955*	24,973	Mito (1,168,686 bu.)	32,723		Rubber, crude		24
Cherries, chilled	944		Mineral talc	22,542*		Rugs, carpets and mats		57
Coal	14	4,598*	Miscellaneous		6,245	Salmon, canned and frozen		3,851*
Coconut, dessicated		185*	Miscellaneous, household goods	162		Salt, crude		183,828
Coconut oil		38,262*	Molasses			Seed, bentgrass	891	
Coffee		867*	Molds, pottery	3	5,131*	Seed, clover	381	
Coke	37,116*		Motorcycles, parts and accessories			Seed, NOS**	9,713*	302
Corn, canned	9,123		Nickel ingots	97*		Seed, ryegrass	4,473	
Corn, frozen	9,592		Nursery supplies	33		Seed grass, NOS**	5,700*	
Cotton	369*		Nuts	838		Shellfish, canned and frozen	197	
Dry goods and clothing		3,048	Oats	111*		Soap and powder	9*	
Earthenware and porcelain		433	Oats, rolled	89*		Soda ash	53,455*	
Electric mfgs.		5,034*	Oil, s'mint, p'mint and essence	187		Soybeans (228,223 bu.)	6,162*	
Electrical goods	18	40,457*	Oil, tall	1*		Tallow	3,854	
Electrode pitch			Old newspaper and waste			Tires and tubes		7,703
Fertilizers	20	283*	Onions	14,136*		Toys		90
Fish, canned and frozen			Oranges, canned	1,057		Trucks	386	
Fish, NOS** and extract	1,794*		Ore:			Tuna, canned		504
Fish meal		26	Alumina	60		Vegetables, canned	405*	
Flour (144,921 cwt.)	7,246		Bauxite	416,211*		Vegetables, fresh	15*	
Foodstuffs, NOS**	4,511	9,727	Ferromanganese	18,740*		Vegetables, frozen	4,581	
Footwear		6,192	Limestone rock	551		Wheat (227,432,348 bu.)	6,822,970	
Fruits, canned	4,390*		Manganese	197,219		Whey powder	566*	
Fruits, frozen	1,605		Ore, NOS**	20		Wire		14,773*
Furniture		1,232*		33		Wood burls and logs	803	
Glass products		307				Wood chips	720,691*	
Glass, window and plate		551*				Wood mfgs.	726*	42*
Hardware and tools		1,316				Wood pellets	311*	
Hay, alfalfa cubes	10,641*					Wood poles	2,011	
Hay, baled	1,924*					Wood pulp	4,654	19*
Hides	35,832*					Wood putty	59	
Hops and extracts	58					Wool		432*
						Yarn, NOS**	430*	
						Zinc	140*	

*Indicates increase over preceding year
**Not otherwise specified

Leading Foreign Commerce Nations

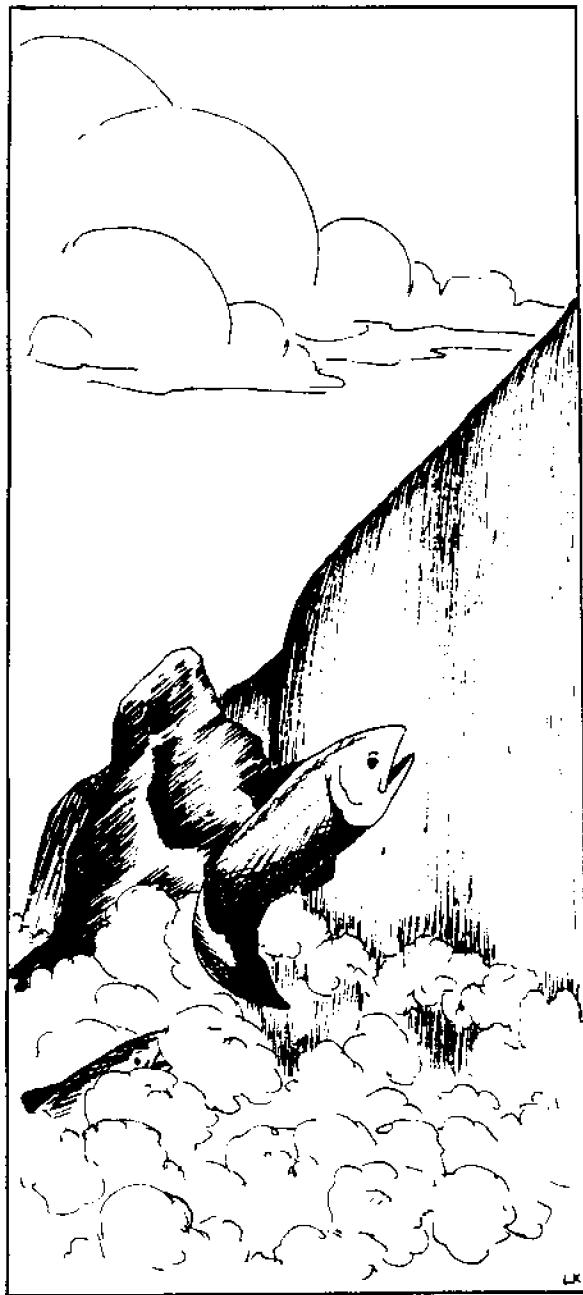
<u>Exports</u>	<u>(Short tons)</u>	<u>Imports</u>	<u>(Short tons)</u>
Japan	3,485,277	Japan	536,224
Republic of Korea	1,478,030	Australia	419,731
Egypt	1,058,867	Canada	244,423
Republic of China (Taiwan)	636,829	People's Republic of China	88,427
India	608,829	West Germany	62,321
Philippines	560,040	Philippines	37,164
Indonesia	410,616	Malaya	34,864
Malaya	258,286	Venezuela	26,724
Belgium	163,421	Belgium	22,064
People's Republic of China	131,302	United Kingdom	13,705

Principal Foreign Exports Handled by
Columbia River Ports Other Than Portland*

Thirteen Leading Commodities (Short tons)

Wheat	4,282,656
Logs	3,596,901
Woodchips	271,069
Lumber	230,548
Barley	207,271
Paper and newsprint	177,749
Corn	176,818
Paperboard	104,433
Beet pulp pellets	97,247
Milo	87,575
Aluminum	63,734
Wood pulp	50,021
Soda ash	38,971

*Astoria, Oregon, plus Kalama, Longview, and Vancouver, Washington

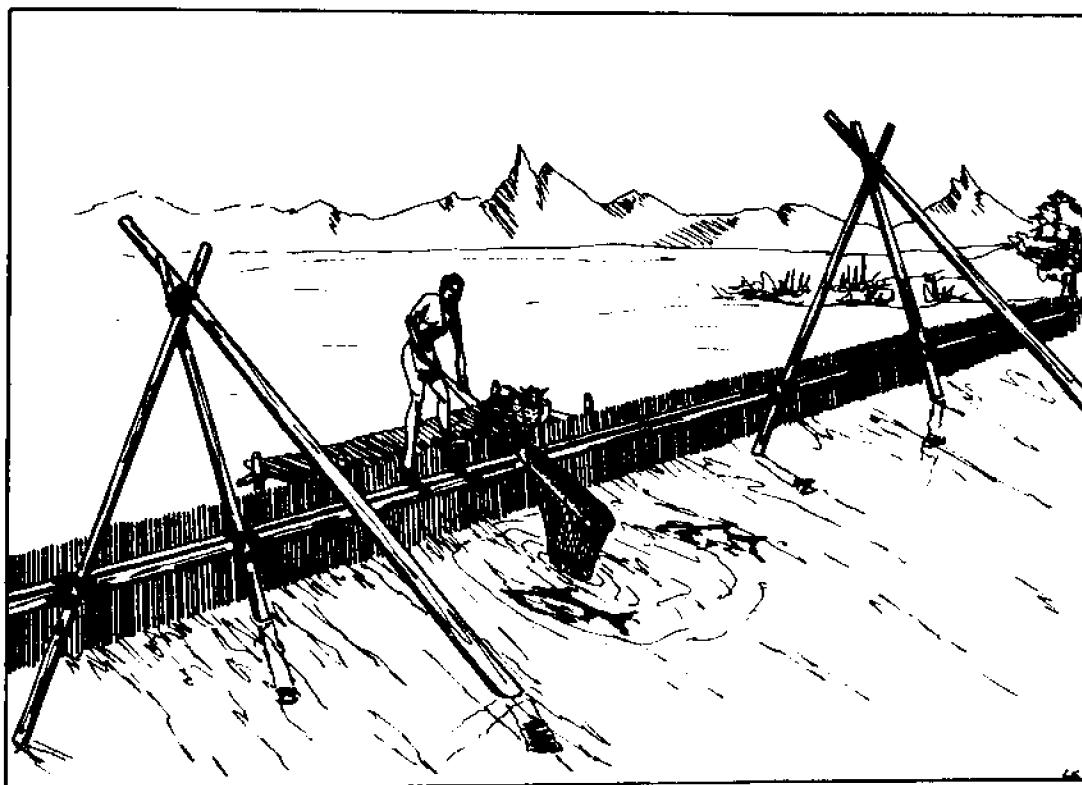


Fisheries

Fisheries: A Reading

Many kinds of fish can be found in the Columbia River system. The largest fish in the United States, the white sturgeon, is found in the Columbia and Snake rivers. Other fish found in the area include American shad, eulachon, Pacific lamprey, northern squawfish, bass, chiselmouth, peamouth, walleye pike, mountain whitefish, yellow perch, and many kinds of sculpins, sticklebacks, daces, shiners, and suckers.

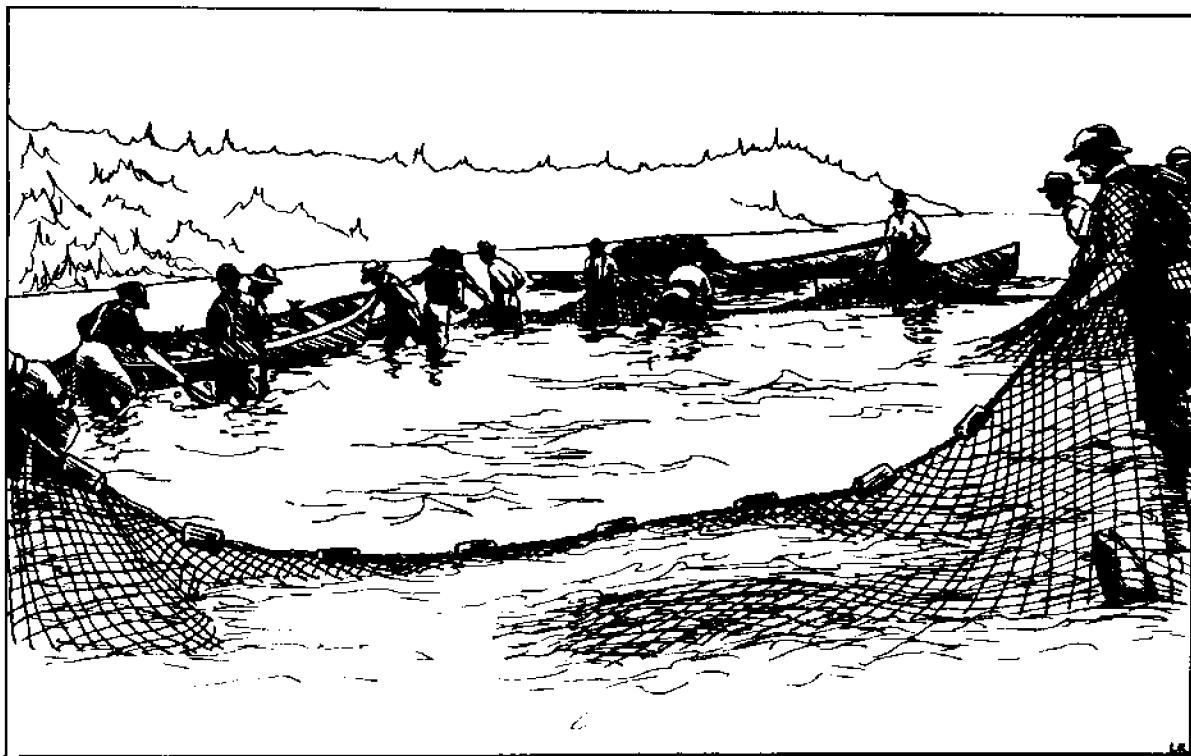
Salmon are the most valuable fish caught in the Columbia system. Commercial fishermen earn money by catching salmon and selling them. Recreational or sport fishermen catch the salmon for fun or for food. Indian fishermen also catch salmon for special ceremonies and activities that are part of their culture. Chinook, coho, sockeye, and chum salmon are different kinds of salmon found in the Columbia.



INDIAN FISHING FRAME

Salmon are a unique fish species. They are anadromous: they spawn in fresh water, migrate to the ocean where they spend the majority of their life, then return to their original spawning area to reproduce.

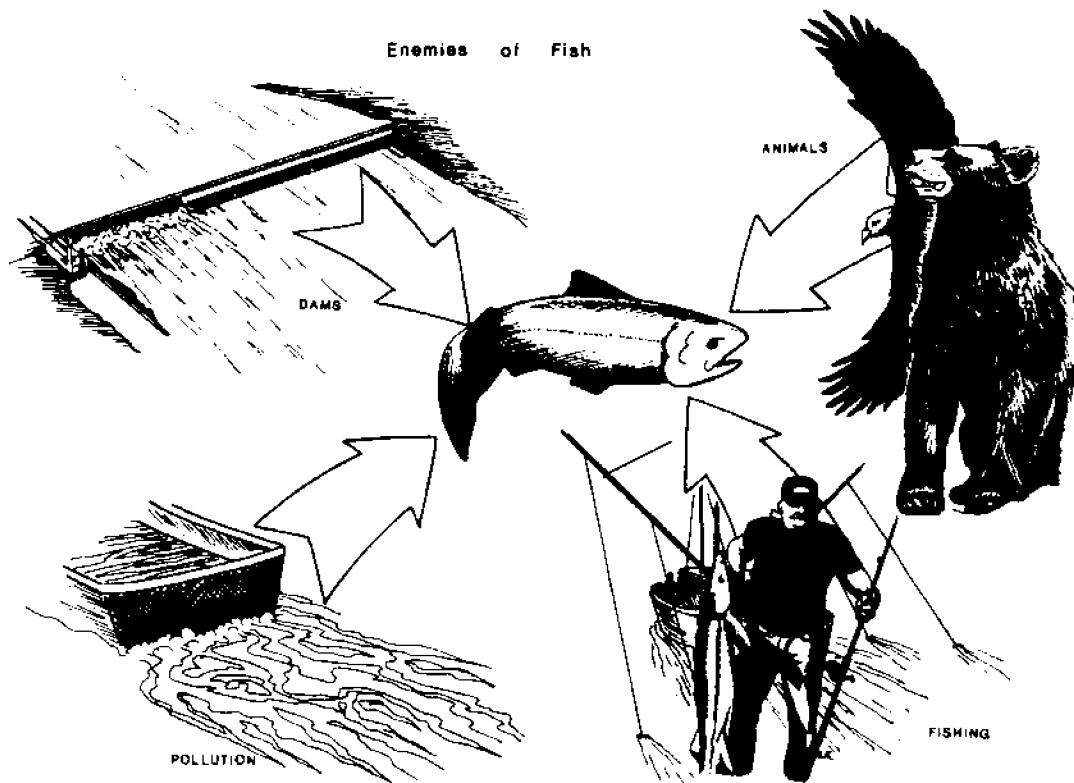
Once the Columbia-Snake River system was the most productive salmon and steelhead area in the world. In 1883, 43 million pounds of chinook salmon were caught. Since that time, the catch of salmon has dropped to less than 5 million pounds (all types of salmon put together) each year. Fewer fish were caught because commercial fishermen overfished the rivers, and poor land practices in mining, forestry, and agriculture destroyed many spawning areas, which in turn reduced the salmon stock. After the 1930s, fewer fish were caught because dams were built. Some dams, like Grand Coulee, were built without fish ladders. Fish could not swim past these dams to their spawning grounds.



SALMON SEINING

Dams cause other problems for salmon. Dams slow the flow of the river. This makes it take longer for young fish to swim down to the ocean. If it takes too long to reach the ocean, the young fish will die. Adult salmon swimming upriver to spawn are slowed by dams and fish ladders, too. Some do not reach their spawning grounds in time to spawn. Passing through the dams is another big problem for salmon. At each dam, 5 to 15 out of every 100 fish swimming downstream die going through the dam's turbines. It has been estimated that only 1 percent of the salmon which begin life survive to return to their home spawning grounds to reproduce--only 1 percent! Today, many government agencies and Indian tribes are working to improve these odds for the salmon in the Columbia River system.

When we are faced with making decisions about how best to use the water in the Columbia system, deciding who gets how much water, we will need to think about these fish. How much water do these fish need to live? How fast must that water flow? How will dams change the life of the fish? How will irrigation change the quality of water for the fish? How will waste disposal change the water for the fish? What will other uses of the river do to the fish? Who benefits from fish being in the river system? Is it important to keep salmon and other fish in the river system?



To gain a better understanding of the salmon, read the following articles:

"Those Unique Salmon" by Malcolm Zirges from Oregon Wildlife, August 1983.

The Columbia River Salmon--A Resource in Danger by Michael S. Spranger. Extension PNW publication, 1984.

Those Unique Salmon

By
Malcolm Zirges
Marine Region

The Pacific Ocean is home to six species of salmon, each different in appearance, migration routes, life history and growth pattern. Most Oregonians only know about five of these, since one is found only in the western Pacific. Let's look at these six species and learn how they differ and why they may have evolved into separate species, how this affects their abilities to adapt and survive in the face of changing environments.

Chinook and coho salmon are found all around the Pacific rim from California to Japan. Chum and sockeye are found mainly from Washington state north and westward to Asia, pink salmon mainly from British Columbia north and west to Asia, and the cherry salmon only around the Sea of Japan.

There is a fish in the Atlantic Ocean called the Atlantic salmon, but it is actually a trout, very similar to our steelhead. Salmon and trout are closely related, however, salmon are thought to have evolved from a trout ancestor.

Steelhead and the Atlantic salmon share an important adaptation of salmon which most other trout generally do not — they are anadromous. Anadromous means the adaptation for spawning in fresh water, but primarily rearing and maturing in the ocean.

Only two salmon species, chinook and coho, are numerous in Oregon waters, supporting extensive sport and commercial fishing. Chum and sockeye salmon also enter Oregon streams. Chums are still produced in some north coast streams and are caught occasionally by ocean fishermen. Sockeye still run into the Columbia River, and contribute a few fish to gillnet



Salmon constitute one of Oregon's most important natural resources. Six species of salmon exist in the Pacific Ocean; five of them are found in Oregon waters.

catches. Oregon does not have resident populations of the pink salmon. Pinks are often caught off the coast of Oregon, particularly by commercial trollers, but they are all from streams to the north of Oregon, primarily the Fraser River of British Columbia.

Why The Differences?

Subtle, but nevertheless unique, characteristics of different streams, and even different areas within specific streams, probably led to evolution of the different species. For example, it is not hard to imagine that a large, fast flow-



Some salmon are genetically geared to run only a short way to their spawning grounds. Others must travel more than 1,000 miles on the energy supplied by stored fats and oils. All Pacific salmon die after spawning.

ing river would favor larger, stronger fish, or that a small, shallow stream would be more suitable for a small fish. So the environment may have molded the different species. It is also obvious if you compare species, that they have unique shapes, coloration, behaviour patterns, and other characteristics, so the fish can tell a member of its own kind.

These physical differences can be fascinating in themselves. Consider the beautiful variegated coloration of a spawning chum salmon, the outrageous red body and green head of a spawning sockeye, the magnificent body size and spotting of a big chinook, or the fierce teeth on the kype, or hooked jaw, that forms on most male salmon near spawning time. But we should get on and explore the ways the different salmon species use different parts of the environment.

We must use many generalizations since salmon, like people, do not all act the same. Salmon are adaptable. There are many cases where one species of salmon has seemingly moved into another's niche because of nontypical water temperatures or some other factor.

Page 4

That adaptability is important for survival. Now let's look at some general characteristics.

Run Timing

Timing is an important element in the use of parts of the environment by the various salmon species. Timing of the spawning run is particularly significant.

The accompanying chart shows the different times that the several salmon species and races of chinook enter and pass through the lower Columbia River on their way to spawning areas. Each stock of

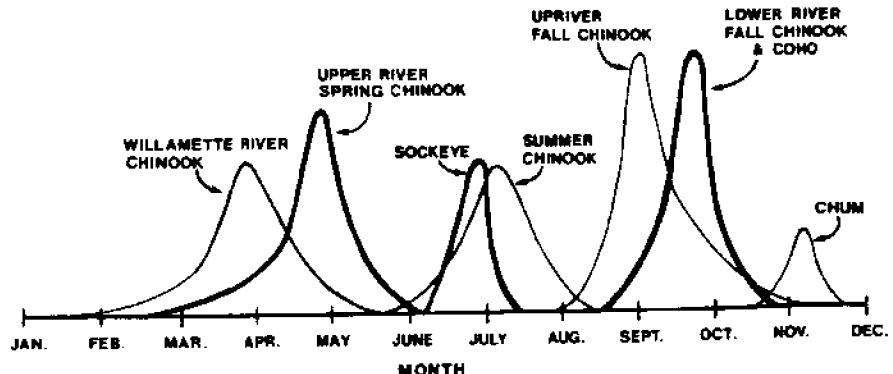
fish has developed a run timing which places the fish on desirable spawning areas at a time when water flow and temperature will be optimum for spawning and, in turn, egg incubation and fry emergence and rearing.

This timing also reflects the distance the particular stock must swim to reach its spawning grounds. Salmon originally spawned from near tidewater up to 1,200 miles in Canada. Since salmon cease feeding when they begin their spawning migration, it is obvious that fish going longer distances need more energy reserves to make the trip. This is done by accumulating more fatty tissue, and the upriver stocks, such as the spring and summer races of chinook, are famous for their high oil content. Short running fish need less reserves and are typically low in oil content. This is particularly true of chum salmon.

Spawning Area Location

Pink salmon typically move the shortest distance into fresh water, often spawning in tidal areas usually within several miles of the ocean. Chum salmon also generally make relatively short spawning runs of only a few miles, although it is not uncommon for them to go 100 miles or more in large river systems. These species prefer relatively untouched small streams that flow directly into estuaries or the ocean.

Chinook salmon generally use the greatest range of river areas for spawning. Chinook may



Time of run passage through the lower Columbia River for different salmon species and races.

AUGUST 1983

spawn from low in the mainstem of large rivers to smaller tributary streams high in a river system. This flexibility has been particularly important to chinook in large river systems that have been dammed for hydroelectric or other uses.

Coho and cherry salmon spawn in the very upper reaches of river systems, often in streams that dry up in the summer months. These streams are in areas most heavily damaged by road building, logging and other developments. These activities sometimes obliterate spawning areas for these species, and also affect water quality needed by the hatching fry.

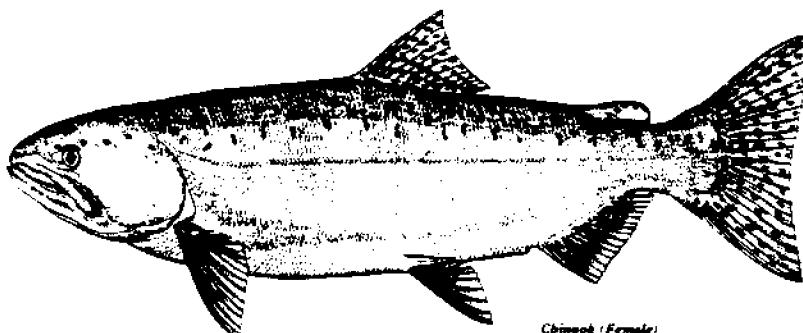
Finally, sockeye salmon have adapted to spawn in streams that are usually above lakes or lake systems. In some areas, the Columbia River system in particular, these lake systems are no longer accessible to fish.

Early Rearing

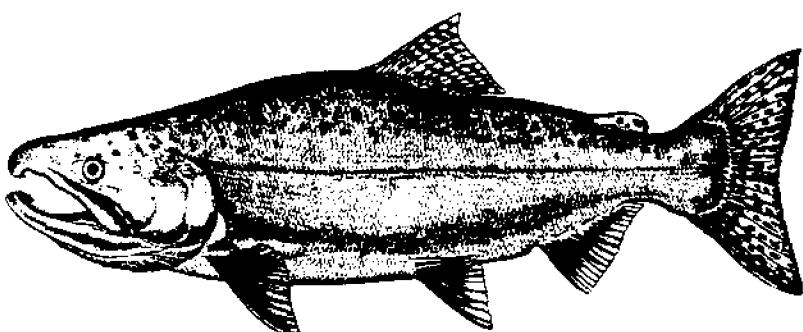
Spawning areas can, and often do, overlap between species of salmon because the needs of the eggs are related primarily to proper flow of water which provides oxygen. Temperature is probably one selection difference between species. For example, sockeye typically seek out and spawn at temperatures ten degrees cooler than chum salmon using the same river system.

Rearing space is very important for the young after they hatch. Suitable rearing areas with the necessary elements, such as food supply, space, cover and other considerations, are limited in most fresh-water environments. Man has had a serious impact on rearing space affecting particularly those species that rear the longest in fresh water.

Chum and pink salmon probably have adopted the most extreme "adaptation" to rearing in the fresh-water environment. They typically do not rear there at all, but leave for the ocean almost upon hatching. Some chum salmon, usually those spawned in larger rivers, do rear in fresh water for short periods, but seldom longer



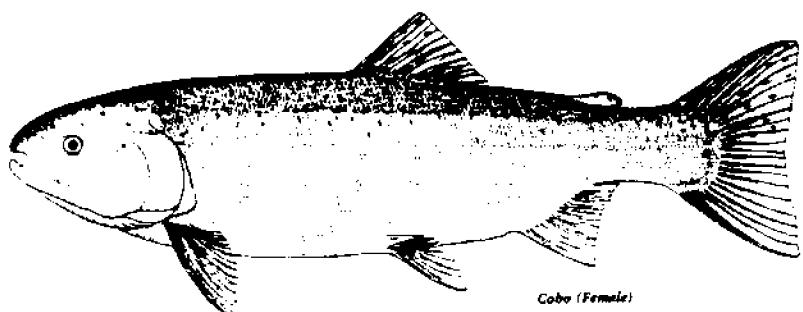
Chinook (Female)



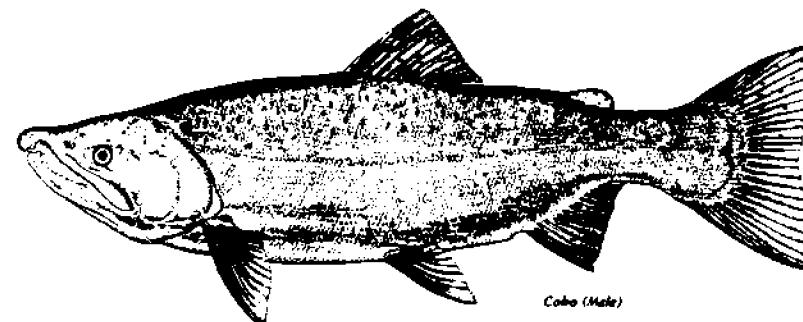
Chinook (Male)

Illustrations by Ron Pittard

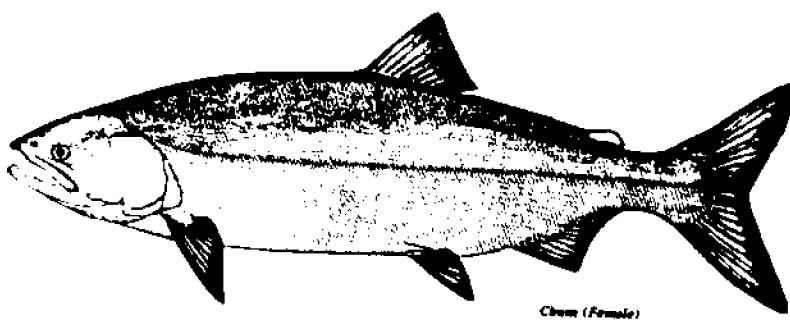
Reprinted by permission from *How to Catch and Identify the Gamefish of Oregon*, by E.A. Lusch, Frank Amato Publications, 1978.



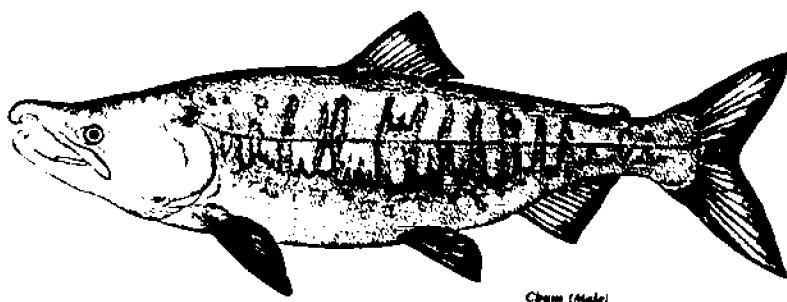
Coho (Female)



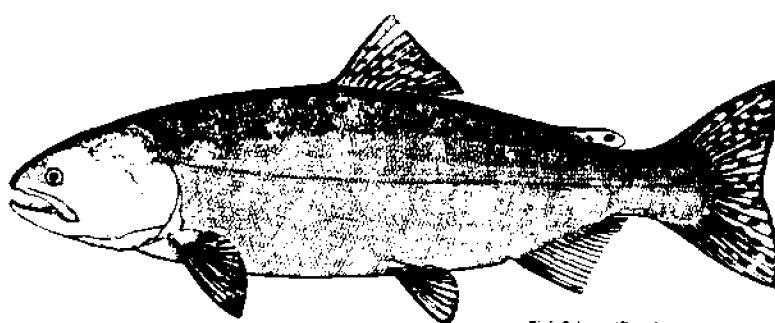
Coho (Male)



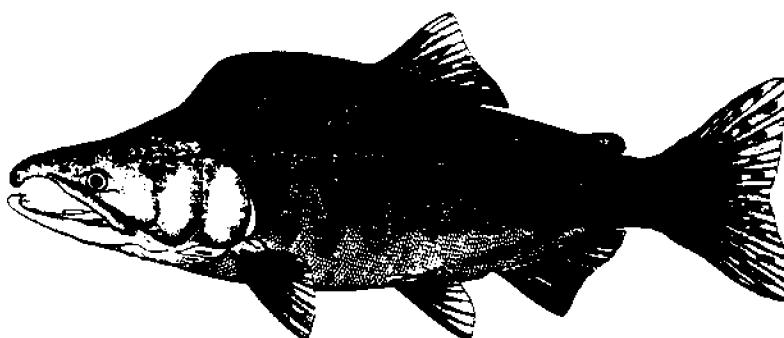
Chum (Female)



Chum (Male)



Pink Salmon (Female)



Pink Salmon (Male)

than two weeks. Oregon chum salmon typically move to sea almost immediately without feeding in fresh water.

Chinook salmon live mostly in large river systems and generally use the greatest portion of those rivers for early rearing. Chinook fry rear from the upriver areas where they hatch out on down into the estuary, typically dropping downstream as they grow and develop. They commonly reside in the river less than three months, except for spring-run fish which stay over a winter in fresh water. Chinook often hold and rear in river estuaries before moving to the ocean. This is very typical in Oregon coastal chinook stocks.

Coho and cherry salmon also drop downstream as they develop, but generally stay in the upper portions of rivers. These species rear over a winter in fresh water, even two or three winters in colder streams in Canada and Alaska. Since streams do not produce a lot of food, particularly in winter, competition is intense in these species. They have developed elaborate territorial behaviour to spread the young fish out — stronger fry get a share of available food and cover while excess fish are forced downstream. Coho fry are even known to run off other species as well where distributions overlap.

Young sockeye salmon remain in fresh water the longest of all salmon species. After hatching and leaving the gravel, sockeye fry move into a nearby lake where they rear for one to three years. They feed on plankton and congregate in schools without the territorial behaviour of coho.

Ocean Distribution

The ocean provides a vast feeding area for salmon, and young salmon spread over much of the north Pacific to grow and mature. The Gulf of Alaska, in particular, is a rich pasture for salmon and all North American species are found there. The different species are not just all mixed up over this area, rather each searches out certain preferred water temperatures and depths. The ocean that seems so

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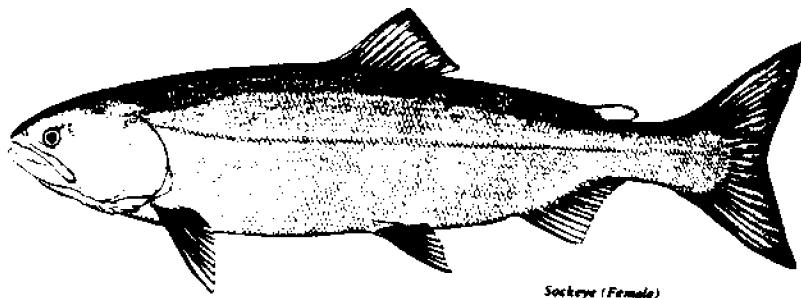
uniform to many people is made up of unique water masses of different temperature, salinity and certainly food organism content.

Pink and chum salmon fry, for example, are very small when they first enter the ocean, so they remain near shore for several weeks, their first summer feeding on plankton and small crustaceans before moving offshore. Later, they are thought to use mostly mid- and upper-water levels, still feeding primarily on small prey items such as shrimp. Chum salmon begin feeding on some fishes as they mature.

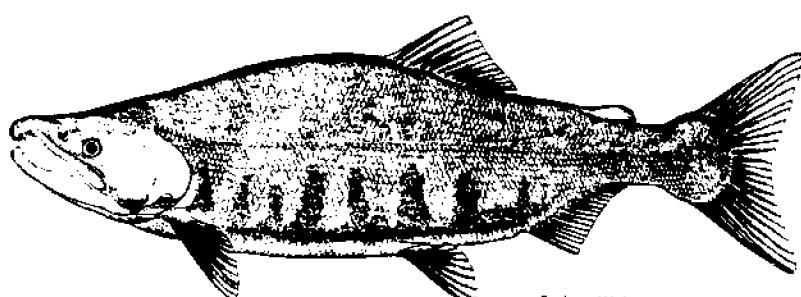
Chinook salmon smolts begin their migration as soon as they enter the ocean, and most chinook, particularly fall-run fish, move northward from their home stream. Their trip can be impressive indeed. For example, one Columbia River chinook was captured and tagged off Adak Island at the tip of the Aleutian Chain, Alaska, and returned to spawn the next year. Chinook like deep water, both in streams and in the ocean, and this species is generally associated with the bottom, or at least deeper water layers in the ocean. Chinook grow rapidly into fish-eaters.

Coho salmon are surface-oriented fish. They move offshore fairly rapidly after leaving fresh water, and are apparently adapted to do this since they are already in their second year of life and are larger than chinook smolts and much larger than chum or pink fry. Oregon stocks have been found both north and south of their home streams. They generally do not move as far as chinook, although their complete migration path is not yet fully known. This species feeds on intermediate-sized prey, including shrimps, squid, crab larvae and small fishes. As much as any salmon, coho feed on what is available.

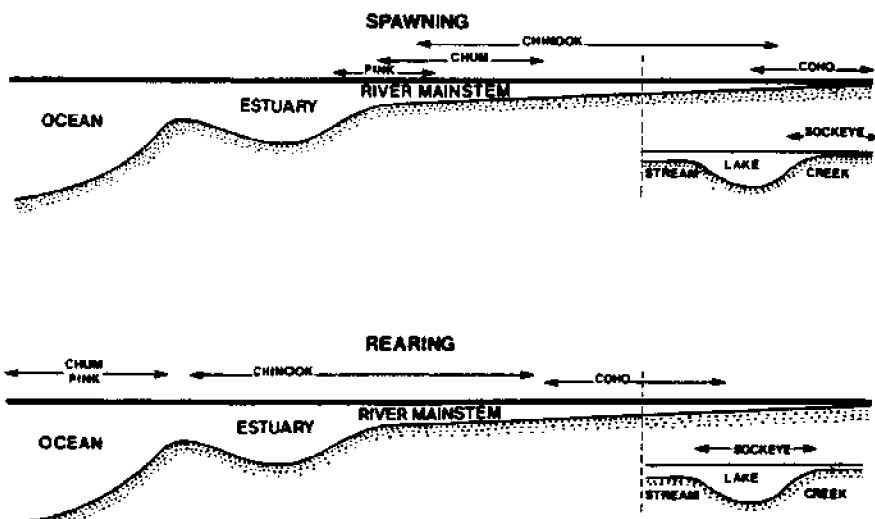
The sockeye is a plankton feeder throughout its life cycle, moving out into the north Pacific in large feeding schools that range to and fro through the swarms of krill and other small ocean animals. This species also seems to orient toward upper water layers, al-



Sockeye (Female)



Sockeye (Male)



General freshwater areas used by different salmon species for spawning and early rearing.

though is not as surface-oriented as the coho. The Japanese fish sockeye extensively with surface gillnets on the other side of the Pacific.

Maturation

Age of maturation is even variable within some species. Chinook mature as late as age four or five and rarely at six. Chinook jacks, or precocial males, however, mature at age two. This characteristic is shared to a lesser degree by sockeye, chum, coho, and cherry salmon. Coho, for example, typically spend two years in the ocean, although some coho males also mature early as jacks. Pink salmon are the exception, invariably maturing as two-year-olds.

Aside from the obvious importance of greater or lesser exposure to ocean fishing fleets and other predators, age of maturity has great adaptive significance when environmental changes occur. In pink salmon, for example, if the eggs from one year's spawners are somehow destroyed in a specific stream, there will be no adults to return to that stream two years later, or two years after that, etc. etc. Only by eventual straying of spawners from some other stream will that stream be restocked. If the destroyed stock was unique in some way, its special characteristics will have been lost.

A variable rate of maturation acts to cushion such disasters. If one year's eggs are somehow destroyed, the fish hatched from eggs deposited one, two, three or four years previous will mature the next year and return to the stream to spawn. This overlap is thought to have important genetic consequences, and species with less age of maturation variation, such as coho, probably are less resilient to change.

If this has seemed like a giant jigsaw puzzle, it is. Salmon are fascinating in their complexity, and have been a fertile field of study for fisheries biologists and other naturalists for many years and will continue to be for years to come.□

Lesson Activities

I. Concepts, Phrases, Words, and Numbers

Define and clarify the following:

1. anadromous
2. spawning grounds
3. smolts
4. predator
5. migration
6. fish passage facilities
7. commercial fishing

As a class, collect any other words and phrases that need to be defined and clarified before a clear understanding can be gained. There are probably many of them in the readings. Discuss them carefully.

II. Class Activities

1. Name some of the different species of fish that live in the Columbia-Snake river system. Which ones are you most likely to eat? Which ones are predators?
2. In what ways are fish and wildlife habitat in the Columbia River basin being destroyed? What measures can be taken to reduce these losses?
3. Assume you have just caught a ten-pound salmon in Idaho's Salmon River. List the hazards the fish faced in its life.

III. Class Discussion or Written Assignments

1. Discuss or write on the following information:

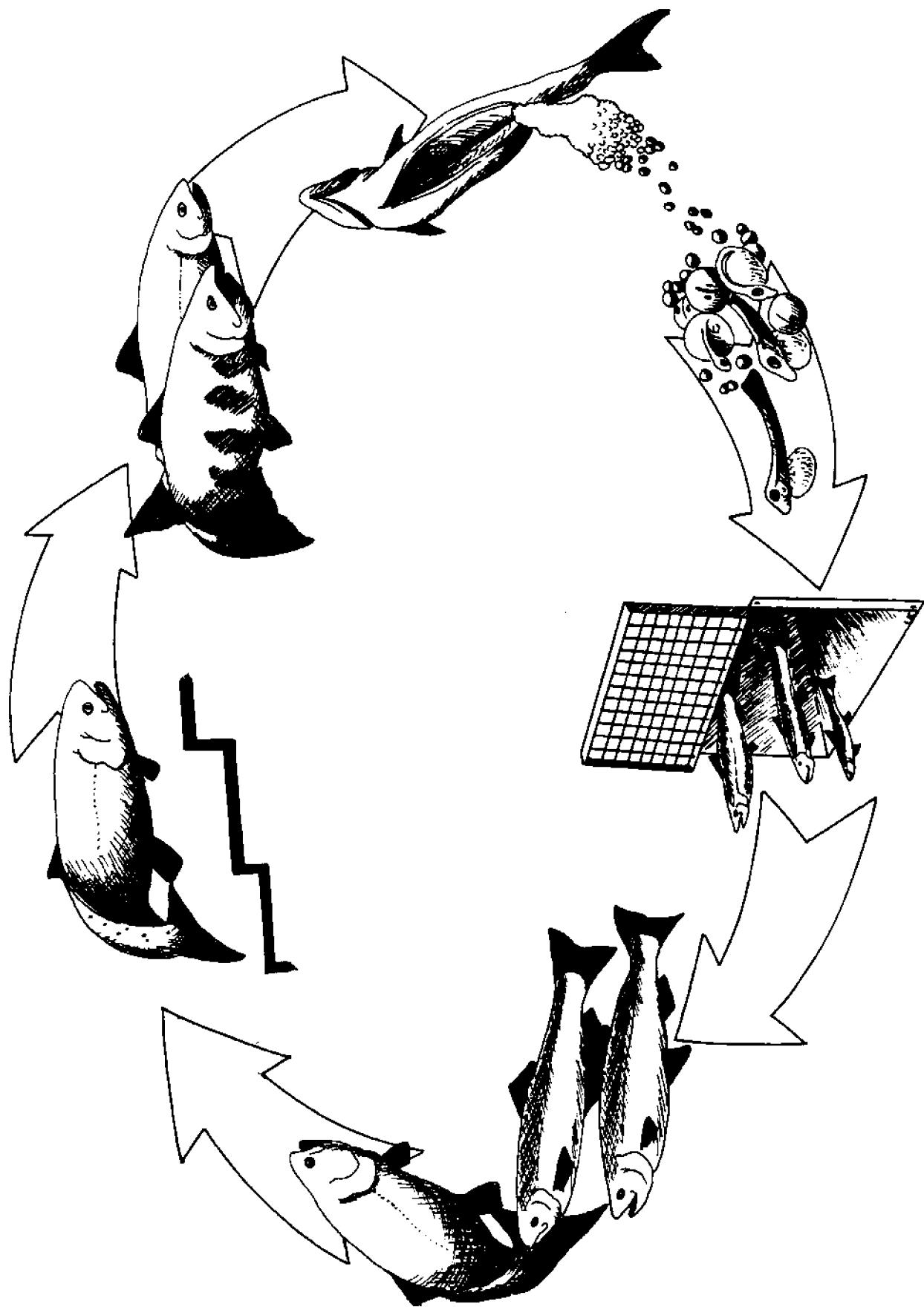
"Efforts are now underway to improve and protect the spawning migrations of the salmon and steelhead. Restoration of the anadromous fish does not come without its costs. Over the next 20 years it is estimated these costs could be up to a

half billion dollars--500 million. It is estimated that the ratepayer could see an increase of \$2-10 a month in an electrical bill to pay for these changes. These changes would probably reduce hydroelectric-generating capacity on the river by about 550 megawatts, which represents about 3% of the Pacific Northwest's needs."

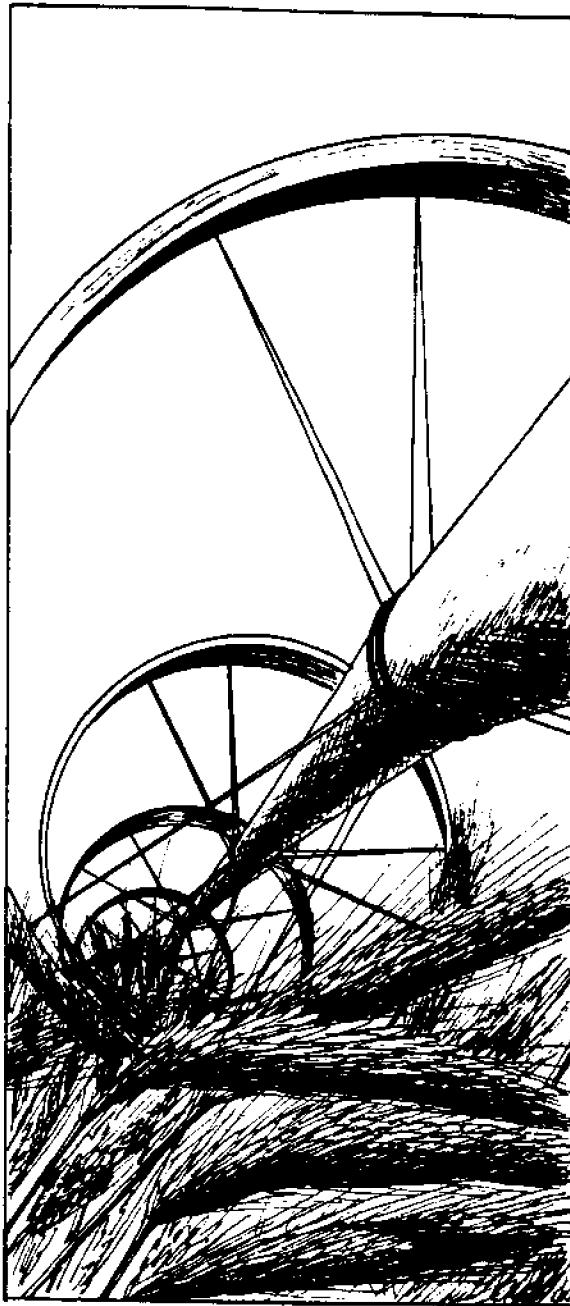
2. Invent and write up one of the following:
 - a. A legend to explain why a salmon returns to the stream in which it was born in order to spawn. Remember, from what you studied earlier, what a legend is.
 - b. A legend explaining why there are so many different species of fish in the rivers.
 - c. A legend explaining the decline of salmon in the Columbia River system.

After you have invented and written your selection, present it to the entire class.

3. Discuss the various fishing methods that have been used to harvest salmon. Which one would you use? Why? What other methods might be used to harvest salmon?

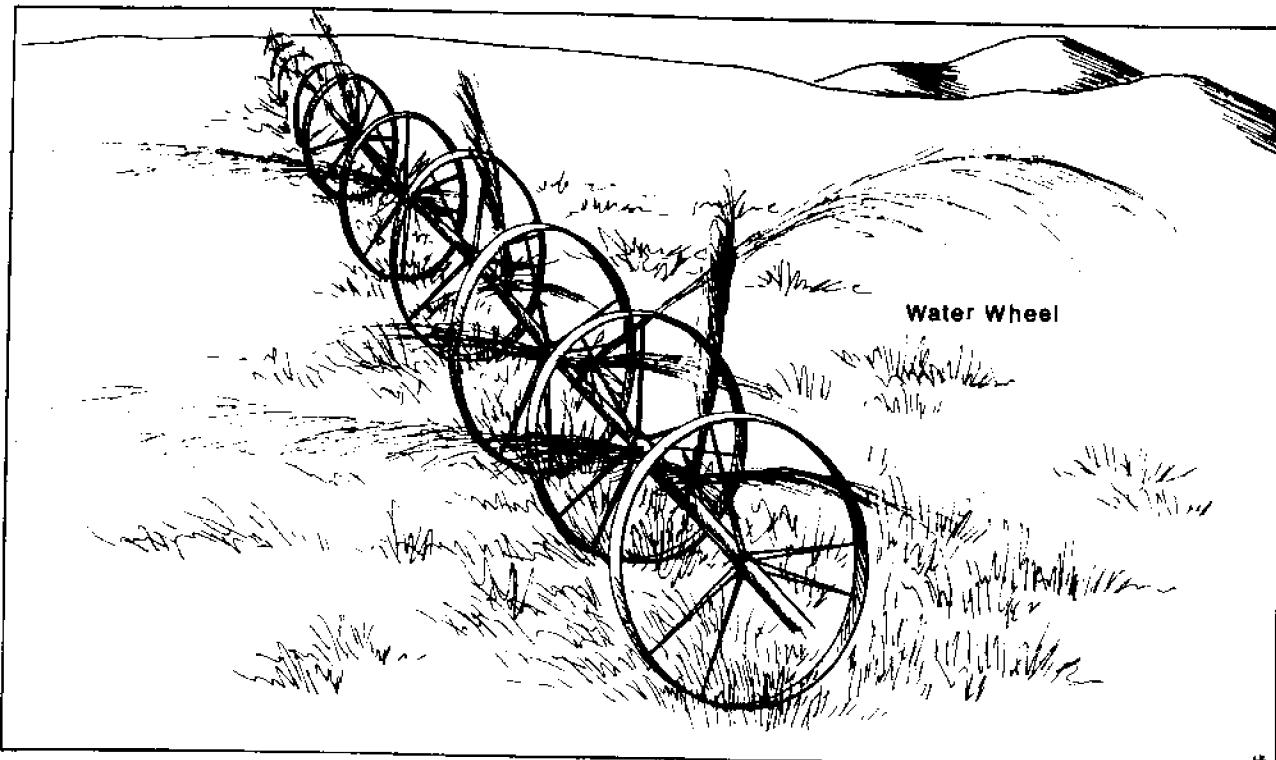


Hatchery Propagation of Salmon



Agriculture

Agriculture: A Reading



The development of large-scale irrigation in the Columbia River basin coincided with the building of hydroelectric facilities. Early on, inexpensive electricity and unused flows of spring runoff each year suggested the potential for unlimited development of vast acreages of irrigable land. Today, irrigation accounts for more than 90 percent of the total water diversion and consumption in the Columbia River drainage area. Some of this water, of course, reenters the river after use. The total acreage at present under irrigation is between 7 and 8 million acres. Within the next 20 years, another 2 to 4 million acres could be added.

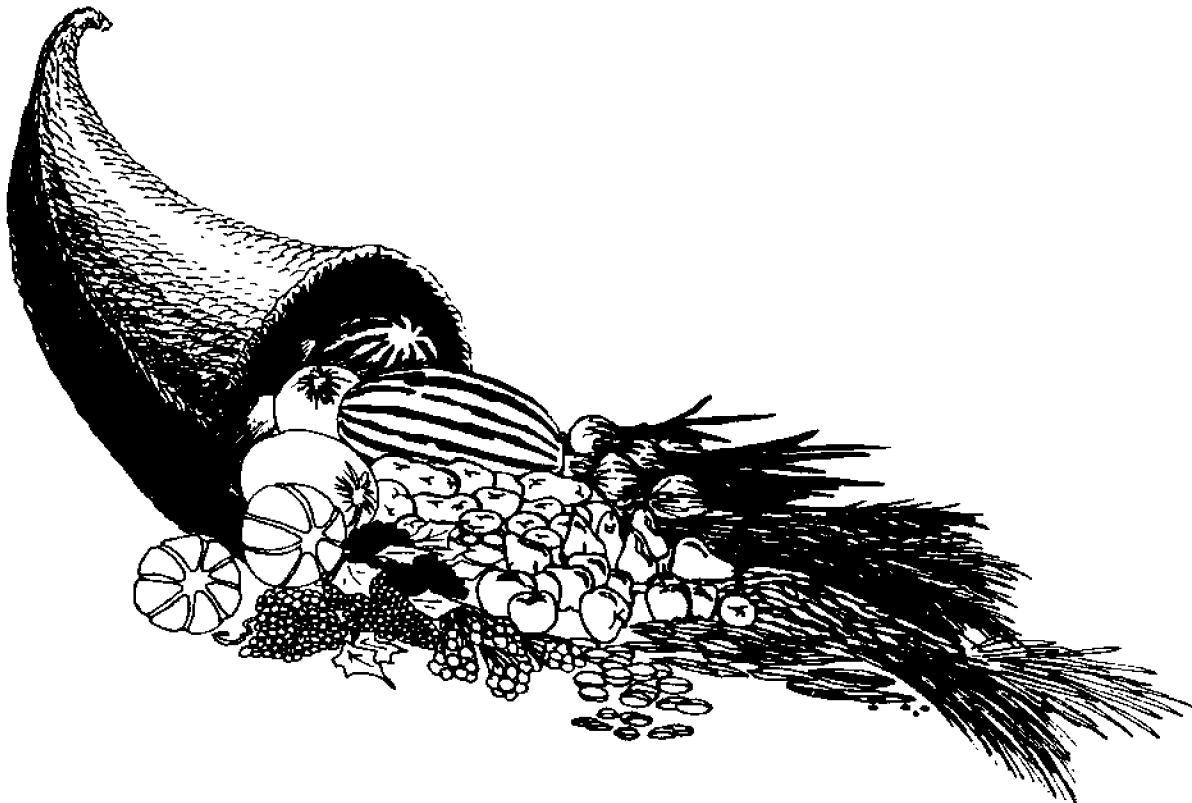
By the time the Columbia's water that begins in Canada and the Snake's water that begins in the Wyoming Rockies join in southeastern Washington, it has nourished livestock, potatoes, peas, alfalfa, beans, hops, and barley, and extensive fruit crops such as watermelons, apples, pears, and cherries. Both large and small farms along the Lower Columbia use its waters for irrigation.

As you already know, 90 percent of all the water that is diverted from the Columbia goes to crop irrigation, and little of that water returns to the river system. Most of it evaporates in the sun or is consumed by the roots of the plants it is intended to irrigate. As

you have been reading all along, if we want to produce these crops, we may have to learn to use the river less for other purposes: fishing, power generation, navigation, and recreation.

In the 1830s when the first missions were established between the Clearwater and the confluence of the Columbia and Snake, water was diverted to irrigate gardens that fed the missionary settlers. When agriculture became a major activity on the Columbia, farmers in the region had to ship the food to the East Coast where the population was. They shipped down the river through the dangerous rapids, out to sea at Astoria, south to the tip of South America, around Cape Horn, and north in the Atlantic until eastern ports were reached. This was a long trip. Northwest farmers were far from markets. Now they are the closest to the all-important growing markets for United States' agricultural products, the nations of the Pacific Rim.

Northwest soils, enriched by volcanic action over thousands of years and lying near one of the vastest river systems in the nation, are extremely productive.



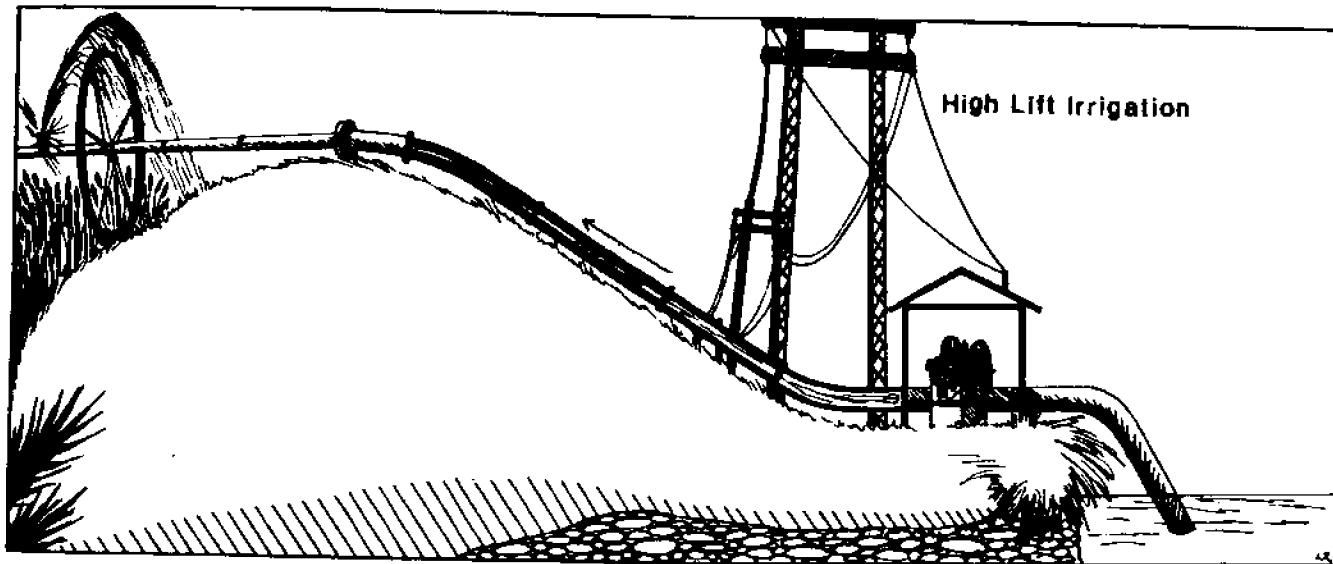
It is not a matter, however, of simply turning on the sprinklers. Lifting and distributing irrigation water is very energy-consumptive. In the case of high-lift irrigation projects, the amount of energy required to lift the water from the river to the farmer's land may be as great, or in some cases, greater, than the energy consumed by

diverting the water for power generation. Lights, TV, stereos, neon advertising, or food? That would be a tough choice.

Few people question using the river's water for irrigating land now in production. However, some of the proposed developments in the Columbia River basin have come under criticism. Much of the proposed development will require large inputs of water, energy, and fertilizer. The cost in both water and dollars will be high. As proposed, the cost for these new developments will be paid largely with public funds. It is apparent that food production is considered vital to the Pacific Northwest as an important export commodity.

It is assumed that if these newly proposed irrigation projects are developed, the flow of the Columbia may be reduced by up to 10 percent. That means 10 percent of the current flow may not be available for the other downstream users of the river.

These circular sprinkler systems and modern pumping methods have been developed to more efficiently bring water to crops, increasing crop yields while lowering water use. However, even with modern technology, the demand for both surface and ground water will continue to increase. Future use of the water for increased irrigation will need to be balanced against other competing uses for the finite waters of the Columbia River system. Trade-offs will need to be made. Everything comes at a cost.



Lesson Activities

I. Concepts, Phrases, Words, and Numbers

What do the following words mean?

1. diverted
2. evaporate
3. Pacific Rim nations
4. volcanic action
5. high-lift irrigation
6. confluence

II. Problems

1. Why do you think the early farmers shipped their crops to East Coast markets by way of the Columbia, around Cape Horn, and up the Atlantic coast, rather than over the Rockies, down the Missouri River and then to East Coast cities and towns? The latter way is much closer. Figure out the exact distance for each route.
2. Look on a map and learn the vastness of the region irrigated by the Columbia and Snake waters. How many square miles are there in 8 million acres? What percentage of this is the Columbia River basin? (260,000 square miles)
3. Where on the map would high-lift irrigation be a necessity? Why?

III. Class Activities

1. Below is a list of some of the crops grown on irrigated farm lands. Discuss the impacts that might occur if irrigation were stopped. Consider what might happen to
 - a. the economy of the region

b. the balance of trade of the United States with the Pacific Rim countries

c. the cost of these products at the grocery stores: wheat, apples, potatoes, beans, cherries, onions, alfalfa

2. Think of the various ways these crops are used in the United States. Are they used in the same manner in the Pacific Rim countries?

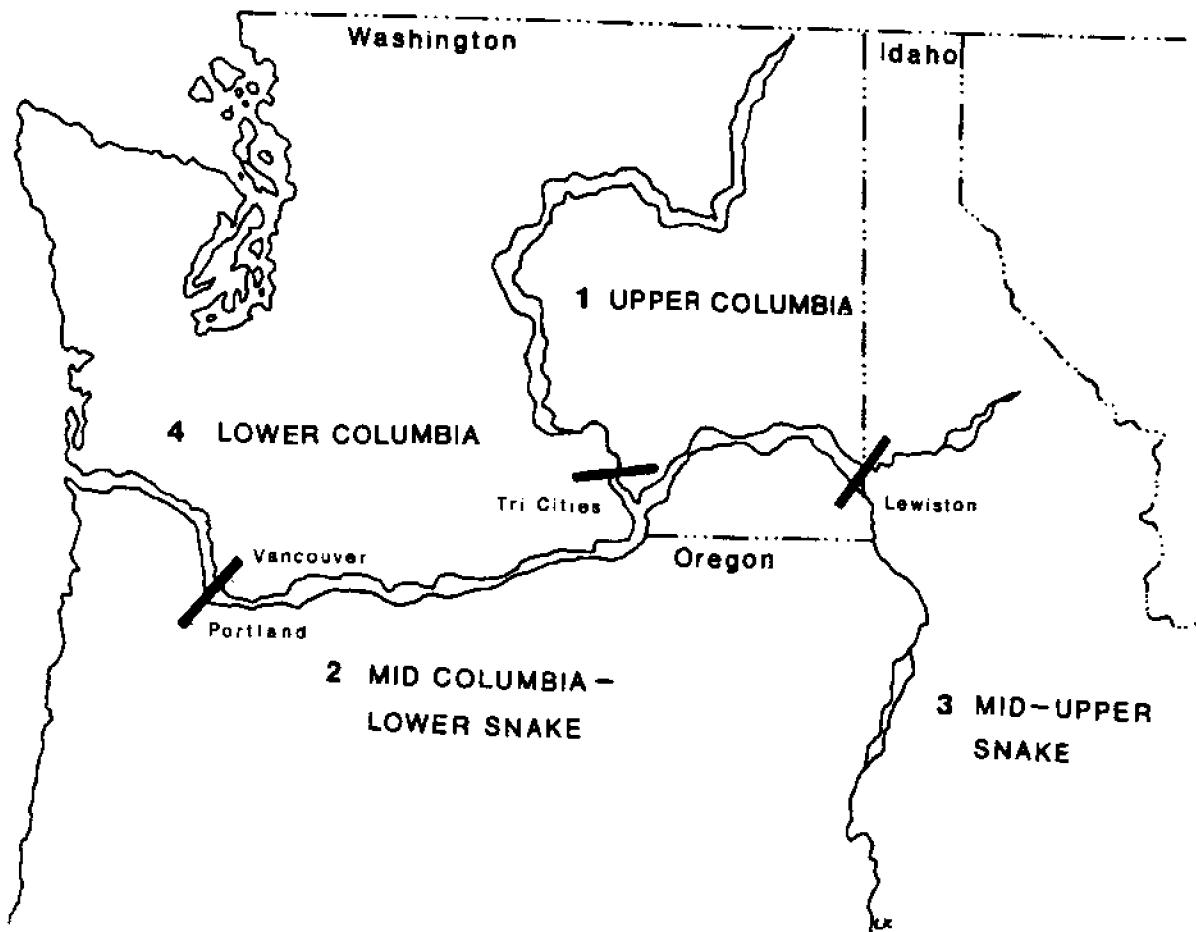
3. How do you think the following taxpayers would view picking up most of the cost of the proposed new irrigation projects?

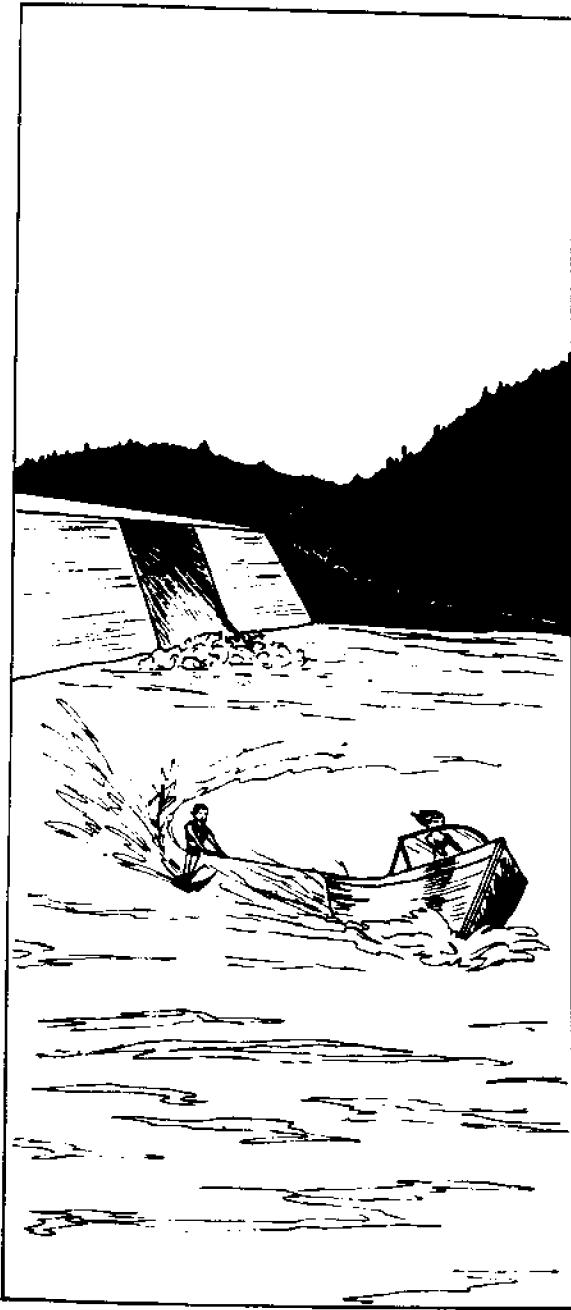
- a. an alfalfa grower near Pendleton, Oregon
- b. an employee of the Port of Portland
- c. a crop worker in the Yakima Valley
- d. a banker in Walla Walla, Washington
- e. a commercial fisherman in Astoria
- f. a cattle or sheep rancher in eastern Montana
- g. a farmer in Missouri
- h. a commercial advertiser in New York City
- i. an owner of an ocean shipping company who lives in Florida
- j. an owner of a recreational boat moorage on the lower Columbia
- k. a logger in Idaho

Think of as many variables and conflicts as you can. For example, one category of one person can be in conflict with other concerns with the same person over other use of the river. Taxpayers are also consumers, electrical rate payers, and sometimes recreational users. They are also, of course, income earners.

You need to see the immediate, perhaps predictable, response of a person's economic interests and the complicated responses of that person's life separate from his source of income.

Four Snake-Columbia River Zones





Recreation

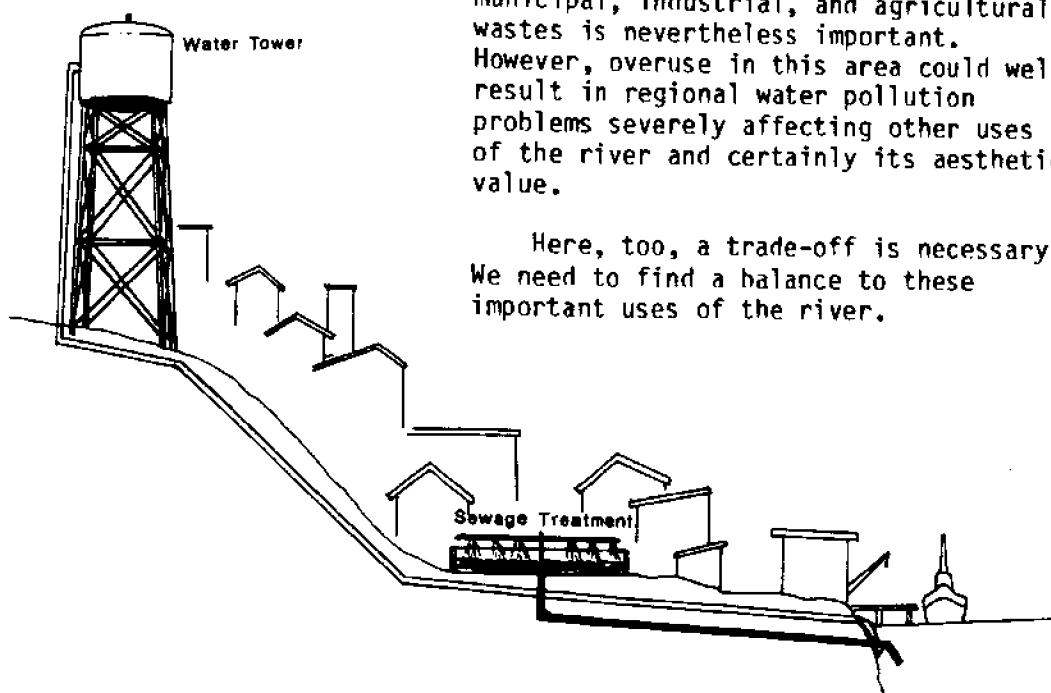
Recreational, Municipal, and Industrial Uses of the River: A Reading

Water-related recreation, such as fishing, power boating, sailing, swimming, and water skiing on the Columbia, is a Northwest tradition and contributes much to the region's economy. It has been projected that recreation on the Columbia-Snake system will increase substantially over the next 25 years. However, attraction to this area will depend on continued access to a clean, safe, natural environment. Poor land management practices and rapid reservoir fluctuations, combined with increased irrigation drawdowns and associated water quality problems, could create a dangerous and unattractive recreational setting which would substantially alter the use of the Columbia River for recreational purposes.

Use of the river for municipal and industrial needs is important. The river is used for our drinking water, as a coolant for industry, and as a place to dispose of our wastes. In the past, major problems centered around maintaining high water quality, mainly for drinking water and municipal waste treatment. Recently, however, there have been discussions of potential water withdrawals that could have an impact on water quantity; for example, cooling towers for thermal power plants to be located near the river could consume considerable amounts of water. In addition, there have been discussions about major out-of-basin water diversions that would provide water for development for domestic, agricultural, and industrial use in other states.

Although neither glamorous nor well known, use of the river to dispose of municipal, industrial, and agricultural wastes is nevertheless important. However, overuse in this area could well result in regional water pollution problems severely affecting other uses of the river and certainly its aesthetic value.

Here, too, a trade-off is necessary. We need to find a balance to these important uses of the river.



Lesson Activities

I. Concepts, Phrases, Words, and Numbers

1. reservoir fluctuation
2. irrigation drawdown
3. waste assimilation
4. water quality
5. pristine

II. Class Activities

1. By now you should have a reply from the town you wrote to some weeks ago.

With the information sent you, do the following:

- a. If you haven't done it yet, read their answers to your questions.
 - b. In class, compare answers from the different towns.
2. Now do the following activity. (If you have not received an answer yet, pair off with another student who has.)

You have won a contest sponsored by a recreational outfitters company. Your award is \$1,000. You plan to use the money for your vacation next summer, and you want to visit the town you wrote. You will travel in a car that gets 21 miles per gallon and uses a quart of oil every 700 miles.

How much will it cost you to travel round-trip to your designated town? How much of the \$1,000 will you have left? What types of things and activities will you spend the remaining money on?

3. In class, compare the different recreational sites and activities on the Columbia-Snake system.

III. Class Discussion or Written Assignment

1. Is it possible to have the river used for recreational, municipal, and industrial use without any conflict occurring? What precautions or actions would be needed, especially if we are dealing with a small community (with limited funds) that needs each of these river uses?
2. Should we return the Columbia River to the pristine state in which it existed before the arrival of the white man? Should we preserve stretches of the Columbia for its beauty? Present arguments, both pro and con.



Summary

Summary: A Reading

In our study, we have learned that the Columbia River is very important in our daily lives. We could say that it is the life blood of the Pacific Northwest. Because the river is used so many ways, we are constantly relying on it--for energy, for food, for lumber and other products, for recreation.

We have discovered that some of these uses compete with one another for the water of the Columbia. We now may have to make trade-offs in the way these waters are used, since there may not be enough water to meet all our needs. Because of the size of the river system and the number of people involved in managing it, determining the balance of these trade-offs is not easy.



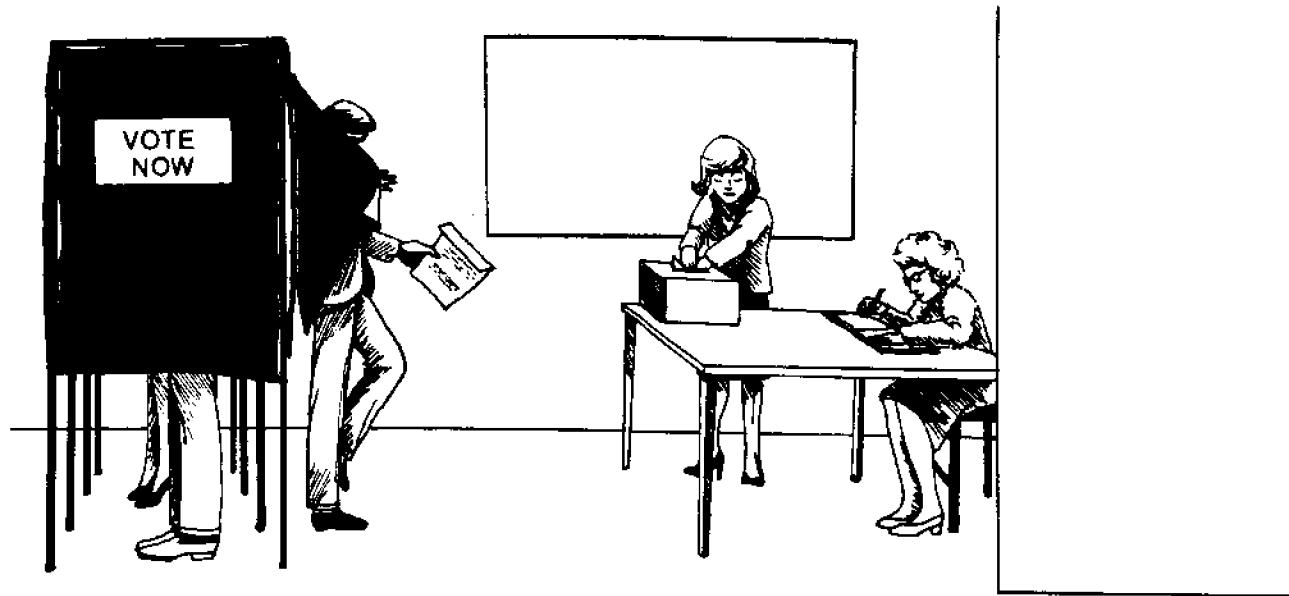
The Columbia Basin includes parts of seven states plus the Canadian province of British Columbia. Some tributaries of the system cross the international border three times before entering the Pacific Ocean. Management authority for power generation, flood control, commerce, and other use is fragmented among local, state, regional, federal, and international agencies. Dozens of specific interest groups, as well as local, regional, and national committees,

are also involved in some aspect of Columbia Basin policy. Because of the complexity and variety of the institutions and interests involved, what has evolved over time is a piecemeal, fragmented approach toward the problems and management of the waters of the Columbia River basin.

It is urgent that something be done. The Columbia River is no longer resilient and inexhaustible. It has clearly begun to show its vulnerability to overuse and to inadequate, uncoordinated, and inconsistent management. The river has been extensively developed for some uses without regard to their effects on other activities, on people, and on the environment.

Over the next few years, the citizens of the Pacific Northwest will be faced with vital regional choices about how, where, and under what conditions our water resources should be used. In this decision-making process, we all have a role to play. By becoming aware of and understanding the issues and conflicts, we will have an opportunity to voice our concerns so that rational decisions regarding the Columbia River will be made. By getting involved ourselves, we can help to ensure that the waters of the Columbia system are allocated in the future to allow a compatible mix of resource use for the benefit and enjoyment of all. The choice is up to us!

Class Activities



1. Discuss the following questions:

- a. Is the future of the river in question as a resource for our present use? After studying the river for some weeks, what do you think?
- b. What can be done, if anything, to make the river an inexhaustible resource?
- c. In what ways can you get involved in the decision making over allocation of the Columbia's waters? Now? When you are of voting age? Consider all possible ways, and then pick some ways best suited for you.

2. Consider the role of government on the rivers. Many different government groups cooperate (and sometimes quarrel) in the management of the rivers. Here are some examples of these government groups. Find out some of the things that they do and their responsibilities:

a. Federal

1. U.S. Army Corps of Engineers
2. Bonneville Power Administration
3. U.S. Bureau of Reclamation

4. U.S. Fish and Wildlife Service

5. U.S. Coast Guard

6. U.S. Environmental Protection Agency

b. Regional

1. Pacific Northwest Regional Power Council (states of Washington, Oregon, Idaho, Montana)

2. Pacific Fisheries Management Council

3. Columbia River Inter-Tribal Fish Commission

c. State (Actual title will vary by state)

1. Department of Fish and Wildlife

2. Department of Natural Resources

3. Department of Environmental Quality

4. Department of Water Resources

d. Local Governmental Agencies

1. County with river-related responsibility

2. Port of a city--established by the State Legislature

3. City

Discussion: Study the above agencies of different levels of government. Which do you consider necessary? Are some more important than others? With increasing use of the river and the need for political trade-offs, would you favor more involvement of regional and federal regulation? Why? Why not?

Carefully consider each of the following situations:

a. If the City of Vancouver decides to limit its protection efforts on the waterfront because of budget restrictions, should Clark County be required to increase its police protection? Should the Port of Vancouver pick up the slack? Who should decide?

b. A group of farmers wants to develop one million acres for irrigation. Large quantities of water will be drawn from the river. This will be of concern to fishermen, fish and wildlife personnel, the Bonneville Power Administration, and other farmers. Who owns the water? What

government groups listed above should be involved? How should the decision get resolved?

3. Write an essay on how the Columbia River affects your life.

After you turn in the essay, compare ideas in small groups. In your discussion, be sure to include industrial and municipal uses of the river, as well as your personal use.

Compile as long a list as the class can of all the ways the river affects people in the Northwest.

4. Return to the questions and discussion on land use that you had during the introduction to this study of the Columbia. Answer the same questions as a class or in small groups. Try to remember how you answered before, and decide if your answers now are more knowledgeable and thoughtful.

Pick one of these locations:

the Clearwater River

the Boise River

the Deschutes River

the Lewis River

the Willamette River

Answer the following questions by using a map, an atlas, or other resources, but first try to answer them from your knowledge.

- a. What major towns or cities are situated on the water?
- b. What state and county are they in?
- c. What dams and industry are near?
- d. Is the area used much for agriculture?
- e. Is the area a popular recreation and sportfishing site?
- f. What other significant areas are located on the river? Hatcheries? Refuges?

Discuss the following:

- a. Assume some county commissioners wish to develop the land around the mouth of the river for a public park with boat ramp, fishing access, swimming, picnicking, and hiking trails. They plan to use 1,280 acres (two square miles) for this purpose.

Which of the following groups would be likely to support the idea? Why?

- 1) Small retail businesses in the towns
- 2) Industry nearby and located on the tributary
- 3) Conservationists
- 4) Farmers whose land is on the tributary
- 5) Local sheriff
- 6) Bankers in the nearby towns
- 7) Citizens of the towns who enjoy outdoor recreation
- 8) Fishermen
- 9) Indians
- 10) Local Chamber of Commerce
- 11) Local PUD commissions
- 12) Federal and state agencies

b. Why do you think the groups you left out would not support the idea?

c. Which groups who usually are on the same side of an issue would generally be in opposition to each other? Why? What arguments do you think the opponents would use against the plan?

d. How would you vote if you were on the Board of County Commissioners? Why? Take a class vote and compare your decisions and reasons. Also try to compare your vote with the one you took earlier.

e. How might this situation change if there were plans to develop a 1,000 megawatt, coal-fired electric generating plant on this site, rather than a public park? What differences would there be in opposition to this plan? Why?

5. Take the post-test--the same one you took weeks ago--and compare your results then with now. After you correct the test, discuss answers with the class.

- a. What directions does the Columbia flow?
- b. Where is the source of the Columbia?
- c. How large is the Columbia River system: (1) length?
(2) square miles?

- d. What is the name of the city at the mouth of the Columbia?
- e. What is the largest tributary of the Columbia?
- f. Approximately how long have people lived along the Columbia?
- g. What is the first dam upstream from the mouth of the Columbia?
- h. Which of the following is not a major use of the Columbia: (1) fishing, (2) agriculture, (3) navigation, (4) scenic wild river, (5) power generation?
- i. Which of the following is a major city on the Columbia: (1) Spokane, (2) Portland, (3) Seattle, (4) Boise?
- j. Why is there political controversy over the use of the river?

Answers to Post-Test

a. It starts in a lake, flows north, turns west, turns south and enters Washington, continues south until the Snake enters near Pasco, turns west to Portland, flows north to Rainier and Longview, and flows west again until it enters the Pacific Ocean.

b. Lake Columbia in British Columbia, Canada.

c. The Columbia River flows more than 1,200 miles before it enters the Pacific Ocean.

The river and its tributaries drain nearly 260,000 square miles--an area comparable to that of France.

The Columbia is the largest North American river flowing into the Pacific Ocean. Its flow is ten times that of the Colorado River. In the United States, it is second only to the mighty Mississippi River in average annual runoff.

d. Astoria, Oregon

e. The Snake, which comes from northwestern Wyoming

f. Natives have lived along the river for 15,000 years.

g. Bonneville Dam is east of Portland about 40 miles. It is nearly 100 miles upstream from the ocean.

h. The Columbia is no longer a wild river. The dams have made it a series of lakes.

i. Portland, Oregon, is on the river. The other cities are affected by the river, but Spokane is east of the river, Seattle is north on Puget Sound, and Boise is on the Snake in southern Idaho.

j. All the water in the river is now being used. Every decision involving a present or future use now requires a trade-off. A trade-off means giving up the benefits of one thing to gain benefits from another. Such a decision becomes political because all groups want to maintain or increase their use of the water.