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Environmental Education

VOLUME 4

INTERPRETIVE SERVICES AND OUTREACH PROGRAM (ISOP)

DEPARTMENT OF THE ARMY
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Project Operations
INTERPRETIVE SERVICES AND OUTREACH PROGRAM
ENVIRONMENTAL EDUCATION

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IMPLEMENTATION OF THE ENVIRONMENTAL EDUCATION AND OUTREACH PORTIONS OF ISOP

The current theme chosen for the Corps Interpretive Services and Outreach Program (ISOP) is "Environmental Education". This theme was chosen because environmental education ensures that we build stewardship into everything we do.

The Corps environmental education objectives are:

(1) To provide both a local and global understanding of the interdependence of life on our planet.

(2) To produce measurable reduction in management problems at Corps projects by promoting the concept of stewardship of natural and cultural resources.

The Corps outreach objective is to reach diverse populations such as students, teachers, organized groups such as Boy Scouts, Girl Scouts and 4-H and the general public beyond the boundaries of Corps projects and facilities. In addition to interpreting the Corps story, outreach activities encourage students to pursue career opportunities in math-and science-oriented fields and to become environmentally astute adults.

TARGET AUDIENCE

The material enclosed is designed to assist you in conducting environmental education programs, both on and off-site, for teachers and youth group leaders. While the examples are targeted for the school environment, participation is also encouraged by scouts, 4-H, and other youth group leaders, as well as the general public. Please don't limit yourself to the suggestions contained here. They are intended as catalysts to help you start an environmental education program, or strengthen an existing one.

WHY TARGET THE TEACHERS INSTEAD OF THE STUDENTS?

It is not usually feasible to present programs to every school class or to every scout troop in the project area. It is possible to reach MANY MORE youths by "teaching the teachers" or leaders.

HOW DO WE ACHIEVE PARTICPATION BY TEACHERS AND YOUTH GROUP LEADERS IN THIS EFFORT?

The key is to make the teacher or group leader feel comfortable leading groups at Corps sites. This can be accomplished using a four-step approach.

STEP # 1: Present all or part of an in-service workshop for teachers. If possible, have the teachers attend the workshop at your site. If this is not possible, bring maps, slides, photos, videos, or any other audiovisual items to the school to give the group a "mental image" of your site. Provide the teachers with

plenty of activity examples and leave them with appropriate handouts. Exhibit I contains a detailed outline for conducting an in-service workshop and an example of a teacher's packet from Chatfield Lake, Omaha District. Of course, the packet must be revised to reflect your particular situation before it is provided to teachers and before they bring students to your site.

STEP # 2: Present an "assembly" type program at the school. This program will introduce the students to the Corps. In addition to facts about the Corps, you should introduce the topic chosen by the teacher to be emphasized when the class(es) visit the site. Emphasize how the topic relates to the students, how it relates to the Corps and your site, how it relates to global environmental issues, and math and science careers. An example is water quality. A slide show or video on the importance of water could be shown and discussion on the above issues may follow. A sample outline and suggested lesson plan using the topic of water quality for a school visit is provided as Exhibit II.

STEP # 3: The class(es) come to the site for a one day field trip. To increase the confidence level of the teacher leading the trip, a Corps team member should meet the group and provide a brief introduction and a tour of appropriate facilities. Here the Corps team member can reinforce concepts introduced during the school visit. Then the teacher will conduct activities using the samples provided to them. The classes will be able to experience firsthand the many resources available at the site. Exhibit III contains sample on-site activities using water quality as the topic.

STEP # 4: Supply the teacher with post-visit activities. A sample using water quality is provided as Exhibit IV. This will further strengthen the concepts learned by the students. To further strengthen these concepts teachers can also make extra credit assignments which will require the students to visit Corps sites (or other natural/cultural sites) to enhance their knowledge of the concepts presented. Included in Exhibit IV is a sample of the Corps "Junior Ranger" program.

IS THE FOUR STEP APPROACH REALLY NECESSARY? RANGERS DON'T HAVE TIME!

Most learning retention occurs by doing, rather than listening to lectures. Using the above steps will promote a partnership atmosphere with many teachers. Many teachers are very reluctant to bring a class to the outdoors because it is a foreign environment to many students. Once teachers feel comfortable in an outdoor environment, Corps participation will become less necessary. Also, if students visit the out-of-doors at an early age they are more likely to develop an environmental ethic.

This four-step suggested approach is just that -- a suggestion to help you develop an environmental education program at your site. It is provided for your use as you deem appropriate. Certainly part of it may be used if all four steps are impractical at your site. The goal in developing an environmentally literate public is encouraging them to think based on the facts, not telling them what to think.

LIST OF EXHIBITS

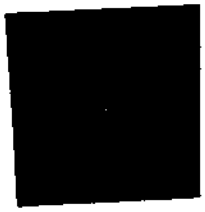


EXHIBIT I

SAMPLE OUTLINE FOR CONDUCTING AN IN-SERVICE WORKSHOP

and

SAMPLE TEACHER'S PACKET

Sample Outline for Conducting an In-Service Teachers' or Group Leaders' Workshop

I. Welcome and Introduction
   A. Introduce workshop staff to teachers (and teachers to each other if from different schools).
   B. Icebreaker Activity (if needed -- i.e. group does not know one another well).

II. Tour of Facilities
   A. Review Map of Project area
   B. Written description of facilities along with a physical tour. NOTE: If the workshop must be held off-site it is important to use brochures, slides and/or video to provide the teachers with an accurate picture of what to expect upon arrival at the site.

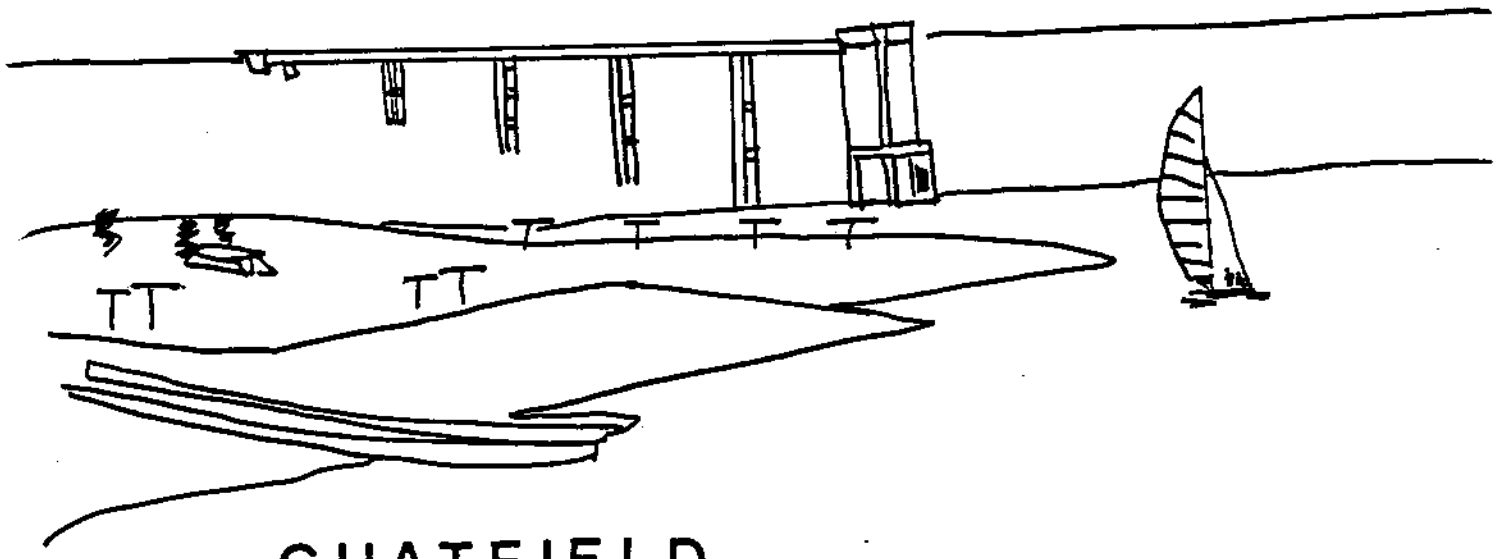
III. Program Theme Options
   A. Briefly describe each theme option. (These are the various program topic choices outlined in your teacher's packet).
   B. Explain how each theme relates to the community, the Corps, the global environmental picture, and individual students' lives.

IV. Activity Samples
   A. Provide Pre-site, On-site, and Post-site activity examples for each of the themes you have chosen.
   B. Conduct the pre, on, and post-site activities with the teachers for at least one of the themes.
   C. Conduct activities for as many of the themes as time permits.

V. Conclude Workshop
   A. Conclude with a question and answer period.
   B. Have participants complete evaluation of workshop.

Workshop length will typically last between 4 and 6 hours. The workshop is important to develop a rapport with the teachers. Having the teachers come to your site is the ideal situation. This familiarizes them with your site, facilities and topography of the area.

TEACHER'S PACKET



CHATFIELD LAKE U.S ARMY CORPS OF ENGINEERS

US Army Corps
of Engineers
Omaha District

INDEX

INTRODUCTION

The staff of the U.S. Army Corps of Engineers would like to welcome you and your students to Chatfield Reservoir. Chatfield is a convenient place for schools from the Denver metro area to reach year round. The area has many of the same biological habitats found throughout metro Denver neighborhoods and therefore can relate directly to the students and help them appreciate the world around their homes. The history and management of the reservoir is part of their world.

The purpose of this packet is to aquaint teachers with Chatfield Reservoir's diversity and adaptability to many different types of programs. The Corps staff will assist teachers in developing a meaningful program for students. There are four parts to the program: planning, presite, onsite, and postsite.

PLANNING

This is the time that teachers and Corps of Engineers staff will establish the goals and objectives of the program. It is a time for an exchange of ideas on activities to help explain the desired concepts. The emphasis will be on relating the program to the classroom studies and the students' experiences.

PRESITE

The Corps of Engineers staff hopes to bring Chatfield Reservoir to the classroom. Background information will be presented through films, slide shows, maps and informal discussions. An effective presite program will make the trip to Chatfield more meaningful.

ONSITE

At Chatfield the students will be taken through the area. The program will include activities by Corps staff, with the teacher's assistance. Here are some points to consider.

1. Dress
Children should be properly dressed for the weather. Due to the location and openness of Chatfield, there is usually a breeze. A good rule of thumb is to dress for temperatures 10-15 degrees cooler than around school or home. It is always better to over dress, than to have too little.

2. Lunch
If you decide to eat at Chatfield, there is a $3.00 entrance fee for each vehicle. Most of the areas in the park are near restrooms. Picnic areas are under open shelters offering protection against the rain and sun. The only time refreshments are available in the park is during swimming season.

3. Transportation
You will need to supply your own transportation between areas at Chatfield. It is highly recommended that the bus stay at Chatfield for your entire visit.

4. Special Needs
In order to try to ensure that all students get full benefit and enjoyment from their visit, we would like to be informed of any special needs, such as physical or mental handicaps, before your visit.

POSTSITE

This is the time students can demonstrate what they have learned through displays, plays, songs, or oral and written exercises.

FACILITIES

1. South Platte Visitor's Center
The solar heated South Platte Visitor's Center has an exhibit area, theater, and beautiful overlook of Chatfield. In a circular pattern, the themes of floods, flood control, dam construction, and the history of the Corps are explained through displays, models, and slide shows. Most of the exhibits relate directly to the Denver-metro area. In the theater, groups can see programs on the Corps' role in the settlement of the West. Presentations are given by one of the Corps staff members.

2. Chatfield Dam Intake Tower
This is the control tower for the gates to the tunnels running under the dam. In the top level, are the controls for the emergency gates, seismograph and elevation guage; the second level has the controls for raising and lowering the gates. The tower is accessible year round but is not heated.

3. Chatfield Dam Outlet Works Tunnel
This is the area where the water flowing through the tunnel either enters the South Platte River, or goes into the irrigation pipes on the downstream side of the dam. Inside the outlet works are the control valves for the irrigation pipes and the end of the tunnel going under the dam.

NATURAL AREAS

Chatfield has a large diversity of terrestrial and aquatic habitats. It is a wonderful place to compare habitats and to study unique plant and animal biological niches.

1. South Platte River
There are dirt paths along the river through forest and shrub riparian communities. Beaver ponds, marshes, and sand bars are scattered along the river. This area is largely forested. It is close to the gravel pit area and classes can walk along the river to the heron rookery.

2. Heron Rookery
This is the second largest heron rookery in Colorado; the largest is in Boulder Reservoir. There are documented records that the rookery is at least 60 years old. Herons are blue-gray shore birds which stand about three feet high. They are very habitual colonial nesting birds, returning to the same nest year after year. When the Corps of Engineers started construction of Chatfield Dam, machinery and people were kept from going under the nests since the birds get nervous when there is activity under them. Since the area has been flooded the number of nesting birds has increased, probably due to the increase in feeding areas close to the rookery. Other birds nesting in the rookery are cormorants. The rookery overlook is also an excellent viewing spot for waterfowl such as ducks, grebes and gulls.

3. Prairie Areas
Eastern Colorado is predominately prairie country. A world unique in its own right, Chatfield has excellent examples of prairie country. There is a prairie dog colony near Plum Creek nature area and pheasants are found throughout the area. Most of the area has been planted with natural grasses and throughout the spring and summer flowers are blooming throughout. Another unique prairie species that can be seen in the prairie dog town is the burrowing owl.

4. Gravel Pit Areas
Gravel has been surface mined along the South Platte in the southwest region of Chatfield. The pits left behind have filled with water and have varying degrees of biological development. Some are barren along the edges with little aquatic life; others have vegetation growing along the sides, and a rich aquatic community. It is an excellent area for aquatic community comparisons, since it is near the South Platte fresh water marsh and easy access to Chatfield Lake.

5. Outlet Works Area
The dead trees along this area mark the old South Platte River channel. Vegetation is starting to grow up along the new channel. This is a good area to study plant adaptability and individual species needs. A comparison of this area with the heron rookery and a forested area would help the students see the effects of change on a natural community.

6. Marsh Areas
Throughout Chatfield Reservoir there are marsh areas along the shore and rivers. Many of the marsh areas are filled with aquatic life and in the spring, waterfowl. During early and late summer, tadpoles are common; as well as aquatic insects. The mud flats attract feeding waterfowl and shore birds.

SUGGESTED PROGRAM THEMES

The purpose of this section is to aquaint teachers with some of the program opportunities at Chatfield. Through a coordinated effort on the part of the Corps staff and teachers, individual programs can be planned so each visit at Chatfield will fit into the overall classroom studies. Discussion of dam operations, construction, water management, and natural communities can incorporate math, social studies, minerology, government functions, geology, and many other subjects. The program approaches are only limited by one's imagination.

THEME: FLOOD CONTROL AND DAM CONSTRUCTION

1. OBJECTIVES:
   - -Show students how the Corps protects people and their property from floods.
   - -Show students how dams are constructed and factors considered in construction.
   - -Show students the factors that are involved in managing water in the reservoir during daily operations and flood conditions.

2. PROGRAM WILL INCLUDE:
   - -Tour of the South Platte Visitors Center
   - -Tour of Chatfield Dam Tower
   - -Tour of dam embankments to see where dam instruments are, such as tiltmeters and piezometers
   - -Tour of outlet works to see the irrigation control valves and tunnel

3. BACKGROUND INFORMATION:

In 1945, the Corps of Engineers completed a report recommending construction of Chatfield Dam. In 1950, during the construction of Cherry Creek Dam, Congress approved and appropriated funds for Chatfield. The local community organized against the dam. The Corps could not build a project without approval of the local community, so plans for Chatfield were tabled.

On June 16, 1965 a storm released its' waters over the Plum Creek Basin, releasing 14 inches of rain in six hours over Larkspurs sending 150,000 cfs (Cubic feet per second) of water down Plum Creek. In Littleton, 104,000 cfs of water flowed down the South Platte. There was approximately 103 million dollars worth of damage done in Denver. Twenty four lives were lost in the South Platte Flood. Cherry Creek Dam stopped 15,000 acre feet of water, which traveled at a peak flow of 58,000 cfs, saving Denver from many more millions of dollars in damages. The success of Cherry Creek Dam and the accurate predictions of the Corps' 1945 study created tremendous support for Chatfield. In 1967 construction started on Chatfield Dam.

4. SUGGESTED CLASSROOM ACTIVITIES

-Have the students interview a friend or relative who would remember the flood of 1965.
-Have students make a one cubic foot box and see how fast they could pass it along to demonstrate a cubic foot per second flow of water.
-Have students locate major dams in Colorado and list the dams with their purpose and controlling agency.

THEME: PEOPLE AS AN ENVIRONMENTAL FACTOR

1. OBJECTIVES:

-Show what effects construction of Chatfield Dam has had on the natural communities of the area.
-Show how all life at Chatfield is interdependent and a reflection of the physical environment.
-Show some examples of how the Corps of Engineers have tried to work with the natural communities to create a more diverse wildlife area.

2. AREAS OF CHATFIELD TO EXPLORE:

-Heron rookery
-Outlet works area--compare the dead tree environment with live tree area
-South Platte River forest--walk along the river to the heron rookery
-Beaver ponds and the old gravel pit areas
-Prairie dog town near Plum Creek

3. BACKGROUND INFORMATION:

In the dry plains, a river community (riparian habitat) is very important for wildlife. In the Great Plains, riparian habitat accounts for one percent of the land area, yet is breeding habitat for 172 terrestrial vertebrates, and feeding habitat for 216 terrestrial vertebrates.

Before the construction of Chatfield Dam, the South Platte River meandered through the present day reservoir basin. Plum Creek joined the South Platte River upstream from the dam.

Flooding upstream from the dam has drowned the trees that used to line the old channel running through the present lake. The Corps of Engineers has removed many of those trees as a safety precaution for recreational boating, but left behind the important trees of the heron rookery.

The trees along the old South Platte River downstream of the dam have died from moving the channel and water away from their roots. Much of the riparian habitat has remained at Chatfield, and has expanded in diversity, due to protection from grazing and cutting. Diversity of wildlife habitat has increased since the completion of Chatfield Dam. The dam has raised the water table in the area, increasing the amount of marshes within the park. The lake itself has added new important feeding areas for waterfowl and shore birds. Many species of swallows catch insects over the open water. The lake also has created new fishing

areas for the osprey, a bird whose population has decreased to a very low level due to DDT pesticide poisoning. Other habitats, such as the prairie, have decreased since the filling of Chatfield Reservoir. There also was a housing development in the reservoir basin, which no longer exists. The changes Chatfield has caused have benefited some wildlife and hurt some others.

4. SUGGESTED CLASSROOM ACTIVITIES
- -From the list of animals found at Chatfield, choose the ones which have and have not benefited from the building of Chatfield. (prairie habitat vs. wetland habitat)
- -Discuss different animal niches and habitat needs
- -Have the children look up information on the great blue heron and it's habitat needs in bird guide books or other natural history books

THEME: NATURAL COMMUNITIES

1. OBJECTIVES:
- -Show students the diversity of natural communities
- -Show students how the physical environment (water table, soil, etc.) effects the type of natural community.
- -Show students how plants and animals adapt to different communities

2. FACILITIES TO EXPLORE AT CHATFIELD:
- -South Platte River area
- -Heron rookery
- -Prairie dog town
- -Gravel pit area
- -Outlet works area

3. BACKGROUND INFORMATION:

Chatfield has a magnificent display of diversity in natural areas. At the South Platte River area students can compare an established riparian habitat with an open prairie. Testing of soils, water quality, temperature, vegetation density and diversity can all easily be done and compared. Younger children can go through the different areas looking for similar and different plants. Animal and plant needs can be discussed and compared. The choice of area of study depends only on time and what types of communities the group most wants to focus on.

4. SUGGESTED CLASSROOM ACTIVITIES:
- -List animals and natural communities found at Chatfield and identify which animals belong to which communities.
- -From the list of animals found here, have teams of two or three students gather information on particular animals.
- -Discuss the needs of animals (food, water, and shelter) and go over food webs and chains

THEME: EXPLORING THE WEST

1. OBJECTIVES:
-To understand why the federal government used the U.S. Army Corps of Engineers Topographical Bureau to explore the west and help encourage western expansion
-To understand the role of the Corps of Engineers in exploring the west

2. FACILITIES TO EXPLORE AT CHATFIELD:
-The South Platte Visitors Center---The main theater has a program on the role of the U.S. Army Corps of Engineers in exploring the west

3. BACKGROUND INFORMATION:

The men who explored the unknown regions of the west were the men of the topographical section of the U.S. Army Corps of Engineers. It was the U.S. Military Academy at West Point which trained nearly all the civil engineers during this time period. The federal government sent out the U.S.Army Corps of Engineers to explore the west in order to learn about the mineral and agriculture potential of the area and places to build forts. They also were required to bring back maps and descriptions to help encourage settlement of the area. The emigration to the west was viewed as a way to secure American control on the area from the English and Mexicans. It was the maps that these men made that the settlers and the miners used to reach their new homes across the land. Many of the explorers published books describing the areas they explored helping to encourage future emigration.

Part of the Corps topographical engineering team was made up of respected naturalists, who studied and reported on the fauna, flora, and geology of this new country. They sent out their detailed reports and specimens, sharing their findings with the world.

As our country became more settled, it was the Corps of Engineers who surveyed the west for the laying of railroad tracks that connected the vast regions of the west with the east. Their efforts helped open up the western section to the rest of the country.

Some Corps explorers: Captain Meriwether Lewis, Captain William Clark, Major Steven Long, Lieutenant John C. Fremont, Lieutenant William Franklin,

4. SUGGESTED CLASSROOM ACTIVITIES
-Find old Corps of Engineers maps, such as the Oregon Trail, and trace the route of the settlers
-Read some of the early explorers' journals to get a feel of the challenges and adventures they frequently faced
-Have the children explore an area around their school and try to make a map of it, for settlers to follow. Describe the biology and geology of the area to attract farmers, ranchers or miners

PURPOSES OF DAMS

1. FLOOD CONTROL

In the Flood Control Act of 1917, Congress charged the U.S. Army Corps of Engineers with flood control responsibilities, and with comprehensive water resource planning. The main reason the Corps of Engineers builds dams is flood control. The three dams around the Denver metro area, Chatfield, Cherry Creek, and Bear Creek, are all built to protect the Denver region from the damaging floods of the past. A flood control dam can catch the fast moving, high volume flood waters, and then slowly and safely release it into the rivers.

2. HYDROPOWER

Hydropower is one of the cleanest and cheapest ways to produce energy. The Corps of Engineers is the largest, single producer of hydroelectricity, supplying nearly half of the electricity to the Pacific Northwest. Power generated at Corps dams is marketed by another agency, such as the Department of Energy, or the Bureau of Reclamation.

3. NAVIGATION

The Corps of Engineers have built dams along the Mississippi River and other areas to help raise and keep a more constant level of water for navigation.

4. RECREATION

Recreation is rarely the main reason for building a dam. It often is one of the side benefits. People enjoy recreation at lakes such as swimming, boating, and fishing.

5. IRRIGATION

The federal agency mainly responsible for water storage used for irrigation is the Bureau of Reclamation. In arid regions where there is not a steady supply of water dams serve an important function of storing water from wet periods and then releasing it during the drier times for farmers' crops. Irrigation dams have helped turn the dry plains into productive agricultural regions.

6. DRINKING WATER

The Denver Water Board is the main agency that builds dams for drinking water storage in our region. The dam functions like a dam for irrigation.

7. MULTI-PURPOSE

Most dams are built as multipurpose projects, combining such pruposes as water storage for irrigation, with flood control and recreation. For instance, Chatfield Reservoir's main purpose is flood control, but it also serves as a recreation site and controls water for irrigation.

South Platte River Flood History of Denver Metro Area

1844- Waters of the South Platte covered bottom lands in Denver vicinity from "bluff to bluff".

1864 - Heavy rains caused floods in May and June.

1876 - Floods occurred due to heavy snow pack and rains

1894 - Flood waters covered hundreds of acres along Front Range

1921 - Flooding in Weld County in early June. Bridges damaged or destroyed

1938 - Flooding along upper South Platte Basin and minor flooding on South Platte River

1942 - Flooding caused excessive erosion and levee failures

1948 - Heavy rains caused flooding between Sand Creek and Fort Lupton.

1949 - Heavy rainfall over melting snowpack caused floods along South Platte River from mid May to June.

1957 - Flooding along South Platte River from Sand Creek down . Large amounts of damage in rural areas.

1965 - June 16 & 17 Flooding occured along the South Platte from Plum Creek downstream to the North Platte.

1969 - Flooding along the South Platte River near eastern plains to the plains.

1973 - Snow melt and rainfall caused flooding along the main stream of the South Platte River.

HOW CORPS PROJECTS GET APPROVED

The local community through lobbyist and their congressional representatives ask the United States Congress to authorize a Corps of Engineers study on the local communities problem, such as flooding. The Corps studies the problem and holds many public meetings to discuss various solutions. The Corps has to evaluate how much a project will cost, against how much it will protect. Part of the evaluation process also includes consideration of various solutions effects on the existing natural environment. The Corps makes a recommendation of a solution. The public responds to the Corps' recommendations through public meetings and letters.

The Corps evaluates the public input, and then hands in a proposal to the United States Congress. Congress reviews the Corps reports, and also continues to receive public input. If Congress approves the project it is put into the Corps budget and sent to the Office of Management and Budget, which reviews the Corps budget and submits it to Congress. Congress then puts the Corps budget into the Appropriations Bill for the President's approval.

msl = mean sea level

DATA ON CORPS OF ENGINEERS DAMS IN DENVER

STATISTIC	CHATFIELD	CHERRY CREEK	BEAR CREEK
Drainage Area	3018 sq. miles	386 sq. miles	236 sq. miles
Maximum Pool Elevation	5521.6 msl	5636 msl	5684 msl
Flood Control Pool Elevation	5500.0 msl	5598 msl	5635 msl
Multi-Purpose Pool Elevation	5432.0 msl	5550 msl	5558 msl
Maximum Pool Surface Acres	6245	4542	1225
Flood Control Pool Surface Acres	4750	2634	664
Multi-Purpose Pool Surface Acres	1479	852	105
Top Of Dam Elevation	5527 msl	5645 msl	5689.5 msl
Spillway Crest Elevation	5500 msl	5598 msl	5667 msl
Crest Length	13,057 ft.	14,300 ft.	5,300 ft. main 2,100 ft. south
Height Above Riverbed	147 ft.	141 ft.	179.5 ft. main 65 ft. south

Table 13a

CONFIRMED MAMMALS ON BEAR CREEK PROJECT.

May 1979

Common Name	Scientific Name
1. Blacktail Prairie Dog	Cynomys ludovicianus
2. Cottontail Rabbit	Sylvilagus audubonii
3. Beaver	Castor canadensis
4. Muskrat	Ondatra zibethicus
5. Mule Deer	Odocoileus hemionus
6. Coyote	Canis latrans
7. Deer Mouse	Peromyacus maniculatus
8. Raccoon	Procyon lotor
9. Red Squirrel	Tamiasciurus hudsonicus
10. Red Fox	Vulpes fulva
11. Colorado Chipmunk	Eutamias quadrivittatus
12. Meadow Vole	Microtus pennsylvanicus
13. Striped Skunk	Mephitis mephitis
14. Mountain Lion	Felis concolor
15. Black Bear	Ursus americanus
16. Harvest Mouse	Reithrodontomys
17. Swift Fox	Vulpes velox

Table 2
LOCATION AND RELATIVE ABUNDANCE OF NATURALLY OCCURRING SPECIES IN THE SOUTH PLATTE RIVER[1]

Species	Bowles Ave. Area	Platte River Drive Area	17th Ave. Area
White sucker (Catostomus commersoni)	C	C	C
Longnose sucker (Catostomus catostomus)	C	C	C
Fathead minnow (Pimephales promelas)	C	C	C
Creek chub (Semotilus atromaculatus)	C	C	
Sand shiner (Notropis stramineus)	C		
Bullheads (Ictalurus spp.)	OC	I	I
Longnose dace (Rhinichthys cataractae)	OC	I	R
Green sunfish (Lepomis cyanellus)	OC	R	
Largemouth bass (Micropterus salmoides)	I	R	R
Yellow perch (Perca flavescens)	R	R	
Common shiner (Notropis cornutus)	R		
Brown trout (Salmo trutta)	R		
Bluegill (Lepomis macrochirus)			R
Rainbow trout (Salmo gairdneri)		R	R
Carp (Cyprinus carpio)		I	OC

*Abundance symbols.

Common	C	Infrequent	I
Occasional	OC	Rare	R

[1] Hepworth, D. K., Results of Stocking Channel Catfish in the South Platte River - An Urban Fishing Program; an unpublished thesis, Colorado State University, 1973.

BIRDS OF CHATFIELD STATE RECREATION AREA AND WATERTON, COLORADO

DATE _____ WEATHER _____

LOCALITY _____

TIME IN FIELD _____ TOTAL SPECIES _____

INDIVIDUALS _____

OBSERVERS _____

LEGEND

W—WINTER S—SUMMER M—MIGRANT
A—ACCIDENTAL Y—YEAR-ROUND

Names of some frequently seen species appear in capital letters.

Compiled by Hugh Kingery and Jan Justice 1982

To Report Additional Sightings, Please Contact Chatfield SRA Office (797-3986).

Colorado Division of Parks and Outdoor Recreation
Colorado Division of Wildlife

M Common Loon —
A Yellow-billed Loon —
M Arctic Loon —
A Red-throated Loon —

A Red-necked Grebe —
M Horned Grebe —
M Eared Grebe —
S Western Grebe —
S Pied-billed Grebe —

M White Pelican —
S DBL.-CR. CORMORANT —

S GREAT BLUE HERON —
M Green Heron —
A Cattle Egret —
A Great Egret —
M Snowy Egret —
M Black-cr. Night Heron —
A Yellow-cr. Night Heron —
M American Bittern —
M White-faced Ibis —

M Whistling Swan —
Y CANADA GOOSE —
M White-fronted Goose —

Y MALLARD
M Gadwall
M Common Pintail
W Green-winged Teal
S Blue-winged Teal
S Cinnamon Teal
M American Wigeon
A European Wigeon
M Northern Shoveler
S Wood Duck
M Redhead
M Ring-necked Duck
M Canvasback
A Greater Scaup
M Lesser Scaup
W Common Goldeneye
M Bufflehead
A Oldsquaw
M Ruddy Duck
M Hooded Merganser
Y Common Merganser
M Red-br. Merganser

M Turkey Vulture
A Goshawk
M Sharp-shinned Hawk
M Cooper's Hawk
Y RED-TAILED HAWK
S Swainson's Hawk —
W Rough-legged Hawk —
M Ferruginous Hawk —
Y Golden Eagle —
W Bald Eagle —
W Northern Harrier —
M Osprey —
W Prairie Falcon —
A Peregrine Falcon —
W Merlin —
Y AMERICAN KESTREL —

Y Ring-necked Pheasant —

M Sandhill Crane —

Y Virginia Rail —
S Sora —
H AMERICAN COOT —

M Semipalmated Plover —
Y KILLDEER —
A Black-bellied Plover —
W Common Snipe —
A Long-billed Curlew —
A Upland Sandpiper —
S Spotted Sandpiper —
M Solitary Sandpiper —
M Willet —
M Greater Yellowlegs —
M LESSER YELLOWLEGS —
M Pectoral Sandpiper —
A White-rumped Sandpiper —
M BAIRD'S SANDPIPER —
M Least Sandpiper —
A Dunlin —
M Long-billed Dowitcher —
A Stilt Sandpiper —
M Semipalmated Sandpiper —
M Western Sandpiper —
M Marbled Godwit —
M Sanderling —
M American Avocet —
A Black-necked Stilt —
A Red Phalarope —
M Wilson's Phalarope —
A Northern Phalarope —

A Parasitic Jaeger
M Herring Gull
S California Gull
Y RING-BILLED GULL
M Franklin's Gull
M Bonaparte's Gull
A Sabine's Gull
M Forster's Tern
M Common Tern
A Least Tern
A Caspian Tern
M Black Tern

A Band-tailed Pigeon
Y Rock Dove
S MOURNING DOVE

S Yellow-billed Cuckoo
A Black-billed Cuckoo

A Barn Owl
Y Common Screech Owl
Y GREAT HORNED OWL
A Pygmy Owl
S Burrowing Owl
Y Long-eared Owl
A Short-eared Owl
A Saw-whet Owl

A Poor-will

S Common Nighthawk
A Chimney Swift
S White-throated Swift
S Broad-tailed Hummingbird
A Rufous Hummingbird
A Calliope Hummingbird

Y BELTED KINGFISHER

Y COMMON FLICKER
M Red-headed Woodpecker
A Lewis' Woodpecker
M Yellow-bellied Sapsucker
A Williamson's Sapsucker

W Hairy Woodpecker
Y DOWNY WOODPECKER

S Eastern Kingbird —
S Western Kingbird —
A Cassin's Kingbird —
A Great Crested Flycatcher —
A Ash-throated Flycatcher —
A Eastern Phoebe —
M Say's Phoebe —
A Vermilion Flycatcher —
M Willow Flycatcher —
M Hammond's Flycatcher —
M Dusky Flycatcher —
M Western Flycatcher —
S Western Wood Pewee —
M Olive-sided Flycatcher —

Y HORNED LARK —
M Violet-green Swallow —
S Tree Swallow —
M Bank Swallow —
M Rough-winged Swallow —
S BARN SWALLOW —
S CLIFF SWALLOW —

M Blue Jay —
M Steller's Jay —
M Pinyon Jay —
M Scrub Jay —
Y BLACK-BILLED MAGPIE —
W Northern Raven —
M White-necked Raven —
Y American Crow —
A Clark's Nutcracker —

Y BLACK-CAPPED CHICKADEE —
W Mountain Chickadee —
M Common Bushtit —
W White-breasted Nuthatch —
M Red-breasted Nuthatch —
W Brown Creeper —

W North American Dipper —
S House Wren —
W Winter Wren —
W Marsh Wren —
S Rock Wren —
M Northern Mockingbird —
S Gray Catbird —

M Brown Thrasher
M Sage Thrasher

Y AMERICAN ROBIN
M Hermit Thrush
S Swainson's Thrush
A Veery
M Western Bluebird
M Mountain Bluebird
W Townsend's Solitaire
A Golden-crowned Kinglet
M Ruby-crowned Kinglet
M Water Pipit
W Bohemian Waxwing
M Cedar Waxwing
W Northern Shrike
M Loggerhead Shrike
Y EUROPEAN STARLING

A White-eyed Vireo
M Solitary Vireo
S Red-eyed Vireo
A Philadelphia Vireo
S Warbling Vireo

A Black-and-White Warbler
A Prothonotary Warbler
A Worm-eating Warbler
A Blue-winged Warbler
A Tennessee Warbler
M Orange-crowned Warbler
M Nashville Warbler
S Virginia's Warbler
M Northern Parula W.
S YELLOW WARBLER
A Magnolia Warbler
A Cape May Warbler
A Black-thr. Blue W.
M YELLOW-RUMPED WARBLER
A Black-thr. Green W.
A Black-thr. Gray W.
M Townsend's Warbler
A Yellow-thr. Warbler
A Chestnut-sided Warbler
A Bay-breasted Warbler
A Blackpoll Warbler
A Prairie Warbler
A Palm Warbler
A Ovenbird
A Northern Waterthrush
M MacGillivray's Warbler
S COMMON YELLOW-THROAT
S Yellow-breasted Chat
M Wilson's Warbler
S American Redstart

A Bobolink —
Y WESTERN MEADOWLARK —
S Yellow-headed Blackbird —
S RED-WINGED BLACKBIRD —
A Orchard Oriole —
A Scott's Oriole —
S NORTHERN ORIOLE —
A Rusty Blackbird —
S Brewer's Blackbird —

S COMMON GRACKLE —
S Brown-headed Cowbird —
M Western Tanager —
A Summer Tanager —

M Rose-breasted Grosbeak —
M Black-headed Grosbeak —
S Blue Grosbeak —
S Indigo Bunting —
S Lazuli Bunting —
A Dickcissel —
M Evening Grosbeak —
A Purple Finch —
M Cassin's Finch
Y House Finch
W Common Redpoll
M Pine Siskin
Y American Goldfinch
S Lesser Goldfinch
A Red Crossbill
M Green-tailed Towhee
Y RUFOUS-SIDED TOWHEE
M Lark Bunting
A Snow Bunting
M Savannah Sparrow
A Baird's Sparrow
M Vesper Sparrow
S Lark Sparrow
A Black-throated Sparrow
W Dark-eyed Junco
W Gray-headed Junco
W AMERICAN TREE SPARROW
S CHIPPING SPARROW
M Clay-colored Sparrow
M Brewer's Sparrow
W Harris' Sparrow
W White-crowned Sparrow
A Golden-crowned Sparrow
M White-throated Sparrow
A Fox Sparrow
M Lincoln's Sparrow
W Swamp Sparrow
Y SONG SPARROW

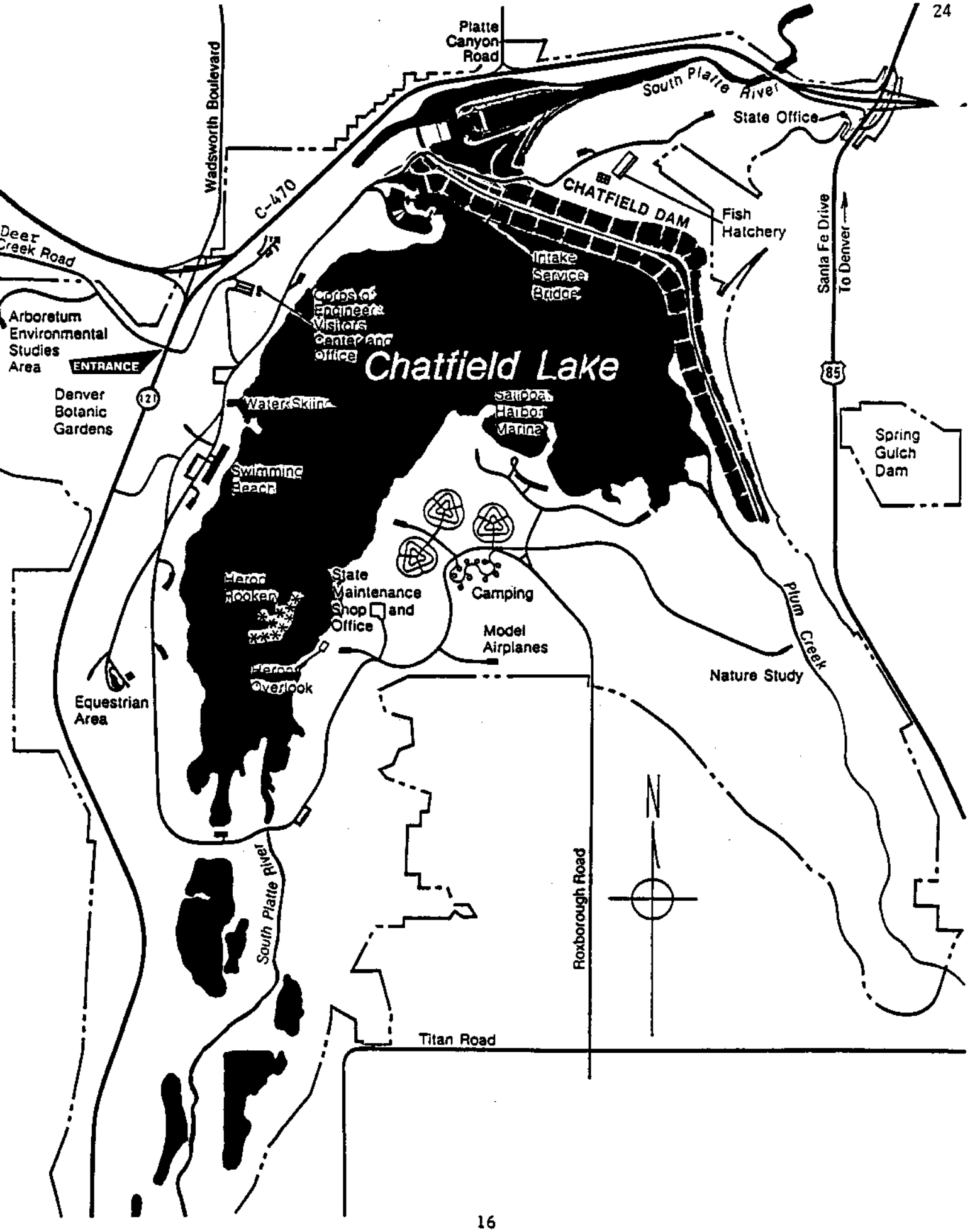

Platte Canyon Road
Wadsworth Boulevard
South Platte River
State Office
C-470
CHATFIELD DAM
Fish Hatchery
Deer Creek Road
Santa Fe Drive
To Denver
Intake Service Bridge
Corps of Engineers Visitors Center and Office
Arboretum Environmental Studies Area
ENTRANCE
Chatfield Lake
Denver Botanic Gardens
121
85
Water Skiing
Sailboat Harbor Marina
Spring Gulch Dam
Swimming Beach
Heron Rookery
State Maintenance Shop and Office
Camping
Plum Creek
Model Airplanes
Heron Overlook
Nature Study
Equestrian Area
N
South Platte River
Roxborough Road
Titan Road

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EXHIBIT II

PRESENTATION OUTLINE FOR A SCHOOL ASSEMBLY
(pre-site visit)

and

SAMPLE PRE-SITE LESSON PLANS

Presentation Outline for a School or Youth Group Assembly
(pre-site visit)

NOTE: The target audience age group for these examples is 5th through 8th grade. Activities can be modified for older & younger groups. This program can be used for a large size group or adapted for an individual class. (The smaller the group the more time for activities. The trade-off is time).

I. Introduce Yourself to the Group

II. Introduce the Topic (i.e. -- water quality)
   A. Ask the group to list things for which water is used. (Write on flip chart). Ask the group to rank them according to importance. (Water for drinking should be ranked first).
   B. Ask how much water each person requires each day.
   C. Ask what happens if the water they drink is not clean.

III. Present an Audio-Visual Program on Water
(The National Wildlife Federation's "Water: We Can't Live Without It," is appropriate).

IV. Ask a Volunteer to Explain the Water Cycle
(Provide a handout or large drawing of the water cycle and have the group to help fill-in the blank names from a list of correct terms).

V. Ask Another Volunteer to Discuss what a Drainage Basin is.
(Provide a map of your particular basin, showing it from headwaters to ocean).

VI. Ask the Group if they Know What Agency You Work For (COE)
   A. Introduce group to the COE and our missions.
   B. Explain the Corps role in flood control and water quality.
   C. Relate the importance of water quality to global environmental quality.

VII. Explain How Your Particular Project Works.

VIII. Discuss Math/Science Career opportunities within your district. (Examples: water quality specialist, biologist, fisheries biologist, hydrologist, etc).

IX. Invite the Group to Your Site

X. Answer Questions

Leave pre-site visit activities with the teachers, along with the on-site visit activities. Firm up on-site visit plans with the teachers.

Following are examples of pre-site, on-site and post-site activities that can be given to teachers before bringing a class to your site.

GO WITH THE FLOW - UNDERSTANDING WATERSHEDS

This activity is from the New York State Department of Environmental Conservation and is used with permission.

Go with the Flow - Understanding Watersheds

A worksheet to accompany the map of major drainage basins in New York State

Background Information

A watershed is a land area that catches precipitation and drains it over or below the earth's surface to a specific water body. A watershed is usually named for the principal stream that drains it. Large watersheds are often called drainage basins. For example, the Genesee River drainage basin, which catches rain and snow in an area from central Pennsylvania through west central New York, directs water into Lake Ontario at Rochester. The Canaseraga Creek watershed is a sub-basin of the Genesee system. In addition, each small tributary stream has its own watershed. A lake or a reservoir is a place in the watershed that provides temporary storage for water on its way downstream. The high areas that bound and separate watersheds are called divides.

Underground, water seeps into the tiny crevices between soil particles and rocks. An aquifer, or saturated zone, contains the usable portion of underground water, or groundwater. Some of the groundwater provides water to rivers and streams when there is no precipitation. Above and below the ground, the water generally works its way through its own watershed, eventually flowing to the sea.

New York State has 17 major drainage basins. In some basins, the headwaters start in other states. Some basins feed into rivers that empty into the ocean far from New York. The large Hudson system is treated as three basins; although the Mohawk, Upper and Lower Hudson basins are all parts of the same river system, they are listed separately for management purposes. Each basin is numbered to make it easier for water scientists and engineers to locate a place or problem and enter it into a computerized data base.

NEW YORK STATE MAJOR DRAINAGE BASINS

01 Lake Erie-Niagara River
02 Allegheny River
03 Lake Ontario and minor tributaries
04 Genesee River
05 Chemung River
06 Susquehanna River
07 Seneca-Oneida-Oswego River
08 Black River
09 St. Lawrence River
10 Lake Champlain
11 Upper Hudson River
12 Mohawk River
13 Lower Hudson River
14 Delaware River
15 Newark Bay
16 Housatonic River
17 Atlantic Ocean/Long Island Sound

Exercise #1 Where does the water go?

On the drainage basin map, draw arrows to indicate the direction of flow in each basin. Basins 1, 3, 4, 7, 8, 9, and 10 drain into the Great Lakes or the St. Lawrence River, which carries their water to the sea. Basin 2 drains to the Gulf of Mexico by way of the Ohio and Mississippi Rivers. Basin 5 joins Basin 6 in Pennsylvania before flowing into Chesapeake Bay. The Hudson Basin system, 11, 12, and 13, drains into the New York-New Jersey Harbor, as does Basin 15. Basin 14 channels water to Delaware Bay near Philadelphia. Water from Basin 16 flows into Long Island Sound through Connecticut. Water on Long Island (Basin 17) seeps into its aquifer layers or flows into Long Island Sound and the Atlantic Ocean.

Connect the New York rivers with their intermediate and final destinations.

Mohawk River	Lake Ontario	Mississippi River	Gulf of St. Lawrence
Genesee River	Ohio River	New York Harbor	Atlantic Ocean
Allegheny River	Lower Hudson	St Lawrence River	Gulf of Mexico

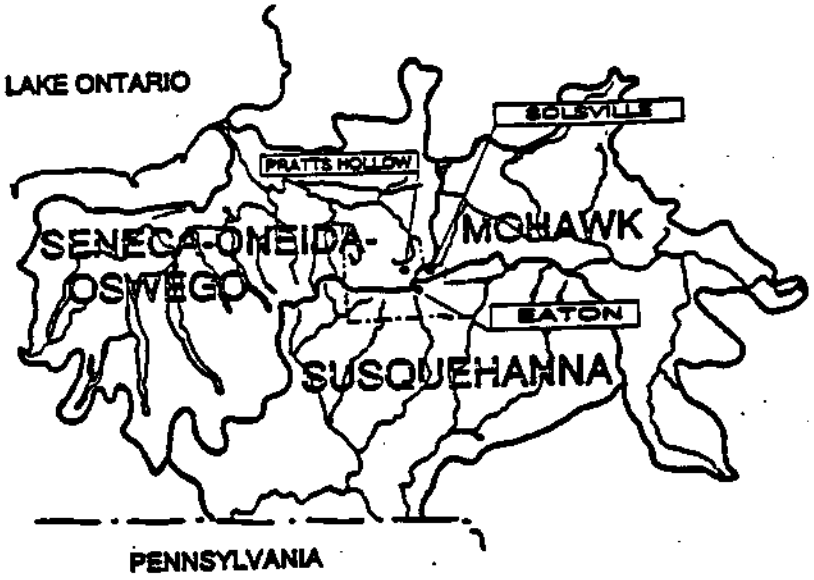
Exercise #2 Divides - the edges of watersheds

Look at the drainage basin map of New York State next to a standard highway map. You may also want to consult a topographic map, available in some bookstores and sporting goods stores. In which drainage basin is your home located? _____ How near do you live to a divide? _____ miles.

If you travel to school or work, do you stay in the same basin or cross into a different one? Find the divide on the highway map. When you travel, note where you pass into a different basin or smaller watershed and think about how far the water must flow to get to the sea.

Exercise #3 Tracing the flow from beginning to end

On the highway map, find Madison County, southwest of Utica. Follow the line of Route 20, just north of Hamilton. Find the villages of Solsville, Pratts Hollow and Eaton, then mark them on the drainage basin map. Although the villages are within eight miles of each other, rain and snow that falls on them will end up thousands of miles apart because the villages are each in a different drainage basin.



Water at Solsville flows east in Oriskany Creek to the Mohawk River. From Pratts Hollow, water flows north in the Oneida River to Oneida Lake and the Oswego River. Precipitation falling on Eaton goes south in the Chenango River to the Susquehanna, and ultimately to Chesapeake Bay. On the drainage basin map, outline the flow from each village. At the edge of the map, write in the route the water follows to the sea.

Exercise #4 The watershed at home

Where does the water go after it washes off your roof? Where is the nearest stream or aquifer? _____ What direction does it flow? _____ Are you near the headwaters (top) or the mouth (bottom) of your watershed? On the drainage basin map, trace the flow from your home, drawing in creeks and streams, if necessary.

Where does your drinking water come from? (name the source)_____ Do you have your own well? ____ Does your drinking water come from a surface water or groundwater supply? (Some communities use both sources.)

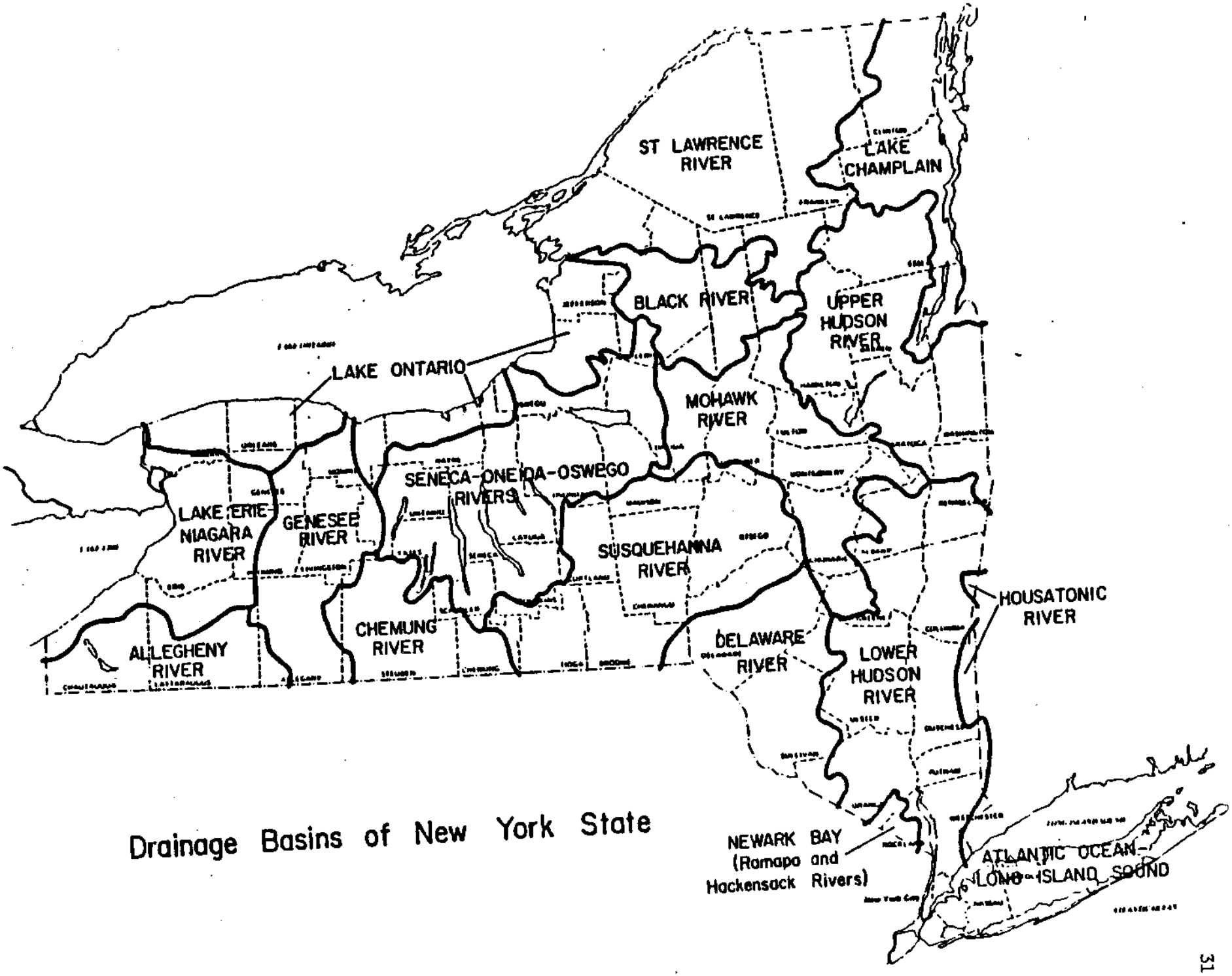
How far does your drinking water travel to get to your home? _____ miles

If a tanker truck containing hazardous materials were to overturn and spill near your drinking water supply, how many people might be affected? If the spill were not cleaned up promptly, how far might the substance travel?

Exercise #5 At home in the watershed

If you throw solvents, like turpentine, or paints or used motor oil onto the ground or on your driveway, where might the substances end up? We all need to be good watershed citizens. During Water Week and throughout the year, we should become more aware of where we live and how our actions affect others many miles away. On another sheet, list actions you can take to prevent downstream pollution.
List any lakes or reservoirs in your watershed that are downstream of your home:

Few of us live near the headwaters of a watershed. Therefore, we are affected by what people do upstream from us. List any cities, villages, commercial or industrial areas that are upstream from your home. Find out what potential pollutants could come from these and other sources. Read the other materials in this packet to find out how New York State works to prevent pollution.



Drainage Basins of New York State

This activity was provided by Pomona Lake, Kansas City District.

WATER WISDOM SCHOOL PROGRAM

Materials:

Water
Clear plastic bag of ice cubes
Coffee maker or hot plate with clear glass beaker
Clear drinking glass
Video Tape on Life in a Pond
Handout on the water cycle

Presentation Set-Up:

Prior to the students arriving, set-up one table in the front of the room. The table will have to be large enough to accommodate all of the equipment listed above or substitutes. On the table set-up the coffee maker, glass of water, bag of ice cubes and the handout on the water cycle. Also have the VCR or video projector ready with a short 10-15 min. video on life in a pond.

Presentation:

This program can be presented in an hour and a half to allow time for questions and interchange with students. A suggestion is to break the lesson into two sections of about 1/2 hour each and provide an additional half hour for questions and discussion. This lesson lends itself to two natural breaks; What is Water, and The Water Community.

Introduce yourself as an employee of the Corps of Engineers and tell them where you work.

Ask the students if they have visited your site and what activities they participated in.

Students should mention activities that are directly related to water (i.e. swimming, boating, fishing and water skiing.)

Tell the students that today you are going to be discussing water; what it is, that it can be found in three different forms, where it comes from and where it is going, and how it provides a community for animals to live in.

Ask the students what water looks like, smells like, and tastes like. Water is a clear, colorless, odorless and tasteless compound made up of hydrogen and oxygen.

Ask students to tell you where water comes from. Students may mention rain, snow, lakes, rivers, the ground, and the water tap. All of these are correct answers.

Ask students to tell you the three forms that water can be found in. If they don't understand the question show them the bag of ice and ask them if this is water. If they answer "No, it is ice!" ask them what will happen when the ice melts. Explain that ice is made of water. Ask them what form water is in when it is frozen (solid). Now direct their attention to the glass of drinking water and ask them what form the water in the glass is in (liquid). Now direct their attention to the coffee maker. The water in the clear glass pot is boiling and steam is coming out of the pot. While pointing at the cloud of steam, ask the students what form this water is in (gas or vapor).

Hand out copies of the handout on the water cycle. Explain how water falls to earth as a liquid when it rains or as a solid when it snows, hails or sleets. We call water that falls to earth precipitation.

Explain that after the water is on the ground the sun shines on it causing it to heat up and change into a gas or vapor which goes up into the air. We call the process where water changes from a liquid to a gas, evaporation. Explain that the sun acts like the coffee maker/hot plate by heating up the water. Explain that we call water vapor in the air humidity.

Explain that when the water vapor rises it cool and changes into tiny droplets of liquid water. When millions and millions of these very tiny droplets of water come together we call them clouds. The process where water vapor cools and changes from a gas to a liquid is condensation. Explain that as more water vapor condenses the water droplets get larger and heavier until they fall to earth as precipitation.

Ask the students if they can see on the handout how the water cycle works. If they don't understand have them follow the arrows.

As an interesting side-light, explain that the water now on the earth is the same water that was on earth when dinosaurs lived here and that the glass of water you drank today may be the same water that a dinosaur drank millions of years ago. This is also an excellent time to explain that only a very small portion of all the water on earth is fresh water. Most of the water on earth is either salt water in the oceans or polluted water that we can't drink. We must conserve our water because of its limited supply. The water we have had on earth for millions of years is all the water we will ever have. We are learning how to take the salt out of seawater so we can drink it, but this is very expensive and uses a lot of energy. We must be careful not to pollute our fresh water so that people in the future will have good water to drink.

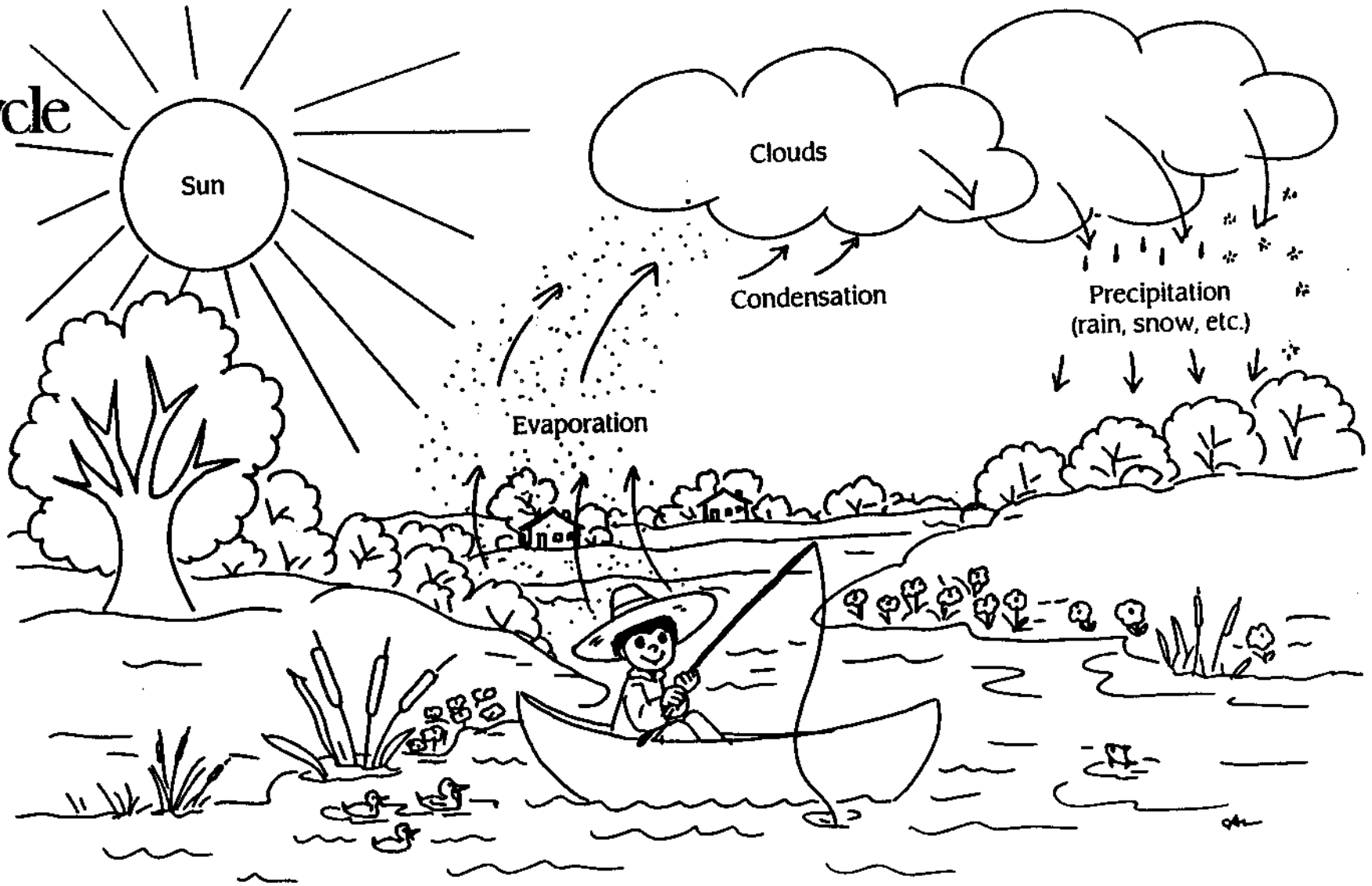
People aren't the only living things that need clean fresh water in order to survive. All animals and plants need water to live. Every cell in our bodies is composed primarily of water. Without water all life on earth would eventually die.

Ask students to name some animals and plants that can live only in fresh water like a pond or lake. Students might name several species of fish, water insects, crayfish, snails, algae and water lilies.

Explain that there are communities of animals and plants that live only in water just like there are communities of animals and plants that live on land. All these plants and animals in a pond community are dependent on one another in a food chain. Emphasize that pollution from chemicals, waste water, oil or acid rain could kill the entire pond community that depends on clean water for its' survival.

(Note: If a video is being used: Before showing video on the pond community, tell students to observe how the animals in the community are dependent upon one another for their survival. After the video, review some of the interrelationships between the plants and animals.)

The Water Cycle



BERLIN LAKE PROJECT

PITTSBURGH DISTRICT

AQUATIC ACTIVITY LESSON PLAN

TOPIC: THE CORPS IN YOUR BATHROOM

INTRODUCTION:

Water is a basic necessity of life. Water falls from the atmosphere onto land or oceans, usually as rain or snow. On land it goes into the earth, reaching rivers, lakes and underground channels and eventually will return to the ocean. In the process of reaching the lake some of the water is used by plants and animals for survival. However, this water can be made worthless because of pollution. If it is unavailable it can cause drought or if it cannot be absorbed into the ground, flooding can occur. Either case is equivalent to its destruction for living things.

GENERAL OBJECTIVE:

To have the visitor or student understand how a dam or reservoir may affect the daily life of an individual by flood control, pollution control, industrial use and recreational activities.

1. Specific Objective:

To have the visitor or student understand the purpose of the dam.

2. Specific Objective:

To have the visitor or student understand the operation of the dam.

Concept:

The major vehicle for achieving our objectives is a portable bathtub used to assimilate a dam and reservoir. A bathtub was chosen for this representation because it is something that an individual (especially a child) is familiar with in his/her day to day routine. If one can see how the parts of a bathtub are very similar to the parts of a dam, then the operation of the dam would be much easier to understand.

Below are the parts of a bathtub and how they may be compared to the parts of a dam.

BATHTUB	DAM & RESERVOIR
Tub or holding basin	Lake or Reservoir
Shower or faucet	Water source such as rain, snow flowing into a river
Overflow	Uncontrolled spillway
Drain plug	Gate valves or Crest Gates
Drain	Outflow from gates and valves downstream.

INSTRUCTION TIME:

Anywhere from 1/2 hour to 3 or 4 hours depending upon situation, interest, the visitor and amount of detail.

MATERIALS NEEDED:

1. Two window well covers - $13 each - $26.00
Options: flannel board - make a bathtub, plastic milk cartons (gallon)

2. Plywood - 4' x 8' exterior sheet - 1/2" to 5/8" thick; Cost $15 - $16, for lip & cradle

3. Piece of rubber inner tube gasket

4. Nuts, bolts & washers - $2.00

5. Shut-off valve for gas line - $2.00, for drain plug

6. Stain or water protector - $2.00

7. 1 5/8" x 75' hose - $9.76

8. Soap Dish - $1.39

9. Adapter - $1.35

10. Nipple - $1.79

11. Shower head - $5.98

12. Hose clamps - $2.00

13. Utility hose - $1.65

14. Plywood box

15. Sand

16. Paper houses

17. Pipe to attach shower head to platform

ACTIVITIES:

I. Flood Plain Activity:

For the visitor to understand the purpose of a dam, the interpreter will use the model of a flood plain. He/she will gradually release water (precipitation) into the river. Example: Runoff? Erosion? Vegetation falling in the water? If the precipitation continues over a great period of time, flooding will occur. Example: Could a house eventually get flooded enough to collapse and wash down stream? How could this have been avoided? - a dam and reservoir. A dam acts as a barrier to hold back flowing water until it can be released gradually at intervals to prevent flooding conditions.

To have the visitor actively participate in this demonstration he/she could operate the water source and experiment with his/her own flooding conditions. While this procedure is going on, ask questions concerning floods and how they will affect our lives.

II. Bathtub Activity:

1. Now that visitor understands one purpose of a dam, he/she should be able to see how a dam operates. First of all explain how a bathtub and dam and reservoir are similar. Work through the parts with the visitor.

2. Once this procedure is completed, the different levels of water in the reservoir should be explained according to the seasons and amount of precipitation entering the reservoir (Example: lake levels at Berlin Lake):

1024. - summer pool - water level maintained for recreational purposes.

1000. - approx. fall pool - lake gradually drawn down to prepare for winter and spring precipitation and runoff.

998. - winter pool - lake kept near this level to prevent flooding in the spring.

1027. - approx. spring pool - water level is increased in reservoir due to spring runoff which in turn prevents flooding downstream.

1032. - flood level

950. - water level at gate valves.

Pretend that there is a very heavy storm in the fall and the lake level is 1000'. What action would you take? Work through other examples at different times of the year.

3. Explain other purposes of a dam such as:

   a. pollution control
   b. recreation - summer pool
   c. industrial use

4. Take the visitor to the actual dam site and give him/her a tour of the dam. With the help of the flood plain model and bathtub demonstrations, the visitor should fully understand the purpose and operation of a flood control project.

Evaluation Criteria:

1. With school group, have a discussion with questions and answers about what they learned and even have them work through a dam operation. They could write an essay using the new vocabulary and concepts they learned. One could work the new knowledge into a math lesson.

The following activity is used by permission of Pennsylvania State Parks.

NOLDE FOREST STATE PARK
ENVIRONMENTAL EDUCATION CENTER
R.D. # 1 BOX 392
READING, PENNSYLVANIA 19607

ACTIVITY 8 **PAGES** 4

LEARNING EXPERIENCE: Water Pollution

CURRICULUM AREAS : Science
Health
Social Studies

GRADE LEVEL : 5th
6th
7th

CONCEPTUAL THEME : Water pollution is a social problem and society is charged with the responsibility to control it.

OBJECTIVES

After completing activity students will be able:

1. To explain the hydrologic cycle.

2. To demonstrate knowledge of the amount of water used by modern man in home and industry.

3. To list various sources that contribute to water pollution (natural and man-made).

4. To demonstrate knowledge of the effects of water pollution upon man.

5. To explain the importance of water to settlers in the United States.

6. To list physical properties of water.

UNIT CONCEPTS

1. All water on earth is recycled in the hydrologic cycle.

2. The average water consumption in the United States is approximately 1,800 gallons per person per day.

3. Water pollutants come from many sources.

4. Water pollution effects our everyday life through increased costs and lost recreational areas.

5. Cities and settlements were started close to water supplies.

PROCEDURE

Class discussion and activities prior to field experience.

1. Discuss the hydrologic cycle. How has man altered or interfered with the cycle? What has the construction of cities done to the cycle?

2. Discuss the physical and chemical properties of water. (Odorless, tasteless, colorless, expands when frozen, becomes lighter when frozen (ice floats), "universal solvent."

3. Discuss water as part of the human body (90% of body weight). Man can live without water only about five days and depends on water for washing, business, industry and recreation. Man uses approximately 1,800 gallons per person or 355 billion gallons per day.

4. Have the students list sources of water pollution.

5. List water users.

Municipalities - use only 10% of the nation's water supply.

Agriculture - approximately 40% of the United States water supply is used for irrigation.

Industry - largest consumer use for cooling, cleaning and power. Contamination of our water supply by industry is our major water pollution problem.

6. Discuss how water is re-used as it flows toward the sea. Does this reuse increase the pollution? Discuss how a river purifies itself as it flows toward the sea. What happened to the Cuyahoga River in 1969? (it burned)

7. List various types of water pollutants: (Sewage, radioactivity, cancer producing chemicals (arsenic, beryllium, chromium), heat, oil, detergents, chemicals (pesticides, etc.), fertilizers.)

8. Discuss the economic impact of water pollution. (Water treatment facilities, fishing industry, recreation, damage to ships, bridges, dams, and other water equipment, and beauty).

9. Where were the first large cities built? Where are the largest cities today? How did the early settlers travel and move goods?

FIELD ACTIVITIES

1. Visit a municipal sewage treatment plant. How does it operate? What happens to the treated waste?

2. Visit a municipal water treatment plant. Where does the water come from? How is it treated? How much does the community use each day? What makes the water fit or unfit for use?

3. Visit various bodies of water in your area - streams, rivers, ponds, lakes. Are they polluted? How can you tell? What kind of pollution is present? Where is it coming from? What could be done to stop the pollution? What kinds of plants and animals live in the water? Were there more or less than you expected?

FOLLOW-UP ACTIVITIES

1. Set up a simple distillation proves to demonstrate how dissolved pollutants can be removed from water. Materials needed are: flask, one-holed rubber stopper, large jar or beaker, small jar or beaker, ice, glass tubing, hot plate or bunsen burner to heat solution, salt (NaCl). Set up the equipment as shown on next page. Fill the flask about half full with a solution of water and salt. Taste the solution. Now boil the solution gently. What happens? Taste the water that forms in the small jar. What happened to the salt?

2. Fill three jars or beakers with distilled water. Label them A, B, and C. Put a tablespoon of detergent in jar A and a tablespoon of fertilizer in jar B, leave jar C as it is. Stir A and B until all the particles are dissolved. Now add an ounce of pond water, which has some algae growing in it. Now set the jars away for two (2) weeks. At the end of this time, compare the three jars. Which jar shows the greatest growth of algae? Read the labels on the detergent and fertilizer boxes to see how much phosphate is in each product. Which jar has highest amount of phosphate? Try the experiment using different detergents and fertilizers. Keep track of the amount of phosphate in each product. Develop a color code to compare samples.

3. You will need three large jars. (Ask in the school cafeteria for jars that pickles or mayonnaise come in). Fill one with water from the faucet. Fill another with water from the faucet plus litter (paper, leaves, twigs) picked up from the school playground. Fill the third jar with pond water or water from a stream. Set the jars aside for several days. Compare the jars. What happened?

4. Set up an experiment to show how water naturally filters itself as it soaks through the ground. Use muddy water and filter it through gravel, sand, and cotton. Which one was more effective? Why? Try a system with layers of cotton, sand and gravel.

5. Set up a terrarium to observe the hydrologic cycle.

6. Form a club to fight water pollution in your community.

[redacted]

EXHIBIT III

SAMPLE ON-SITE ACTIVITIES

The following activity is used by permission of author Carl Hursh formerly of Slippery Rock Area School District where it was printed in "Interdisciplinary Environmental Education Handbook".

M A T H E M A T I C S

CONCEPT: ECOSYSTEM

UNDERSTANDING: The number of people that a stream can support can be determined by calculating stream flow.

SKILLS: PROBLEM SOLVING, TECHNICAL SKILLS, CONSUMER SKILLS

MATERIALS: TAPE MEASURE, 5 TO 6 INCH STICK, ACCESS TO A SMALL STREAM

TIME: 1 HOUR

CALCULATING STREAM FLOW

Stream flow affects the species of plants and animals that can live there. In slow moving streams, species of plants and animals may be similar to those in a pond. Animals from slow moving streams usually require less oxygen. Examples of animals found in slow moving streams are: suckers, water striders, and turtles. On the other hand, fast moving streams with better oxygen levels can support animals like trout and the larvae of the caddis fly.

A. Measure and stake an area 100 feet along a section of stream. Throw a five or six inch stick into the stream. Record the number of seconds it takes to float the stick the 100 foot distance. Run the test three times and average the amount to get an accurate reading.

1st reading 100 ft. div. by number of seconds =_____ft./sec.
2nd reading 100 ft. div. by number of seconds =_____ft./sec.
3rd reading 100 ft. div. by number of seconds =_____ft./sec.

B. Measure the width of the stream at three different places within the 100 foot length. Then, average the width.

1st measurement_____ft.
2nd measurement_____ft.
3rd measurement_____ft.
Total_____ft. div. by 3 =_____average depth

C. Measure the depth of the stream in three places, in a straight line across the stream. Average the depth of the stream.

1st measurement_____ft.
2nd measurement_____ft.
3rd measurement_____ft.
Total_____ft. div. by 3 =_____ft. average depth

D. To find the number of cubic feet of water per second flowing through the stream, multiply the average width, the average depth, and the number of feet the stick floated per second.

_____ft.	X	_____ft.	X	___ft./sec.	=	___cu.ft./sec.
avg. width		avg. depth		rate of flow		volume of flow

E. It has been estimated that the average person uses 200 gallons of water every day in the home. Determine how many people the stream can supply for one day.

_____	X	___7.48___	=	_____		
stream flow in cubic ft./sec.		gallons in 1 cu. ft. of water		gallons of water/sec		
_____	X	_____	=	_____		
gallons/second		sec. in 1 minute		gallons of water/min.		
_____	X	_____	=	_____		
gallons/minute		no. of min. in a day		total gallons of water in 1 day		
_____	/	200 gallons	=	_____		
total gallons of water in 1 day				no. of people supported by stream		

QUESTIONS:

1. How can people reduce the amount of water they use every day?

2. How many people use the stream as a water source? Is it being overused?

3. Should water consumption be regulated in places where there are shortages?

NOTES:

_____

_____

WHAT'S LIVING IN OUR WATER

- A STREAM STUDY

Submitted by: Caesar Creek Lake

Louisville District

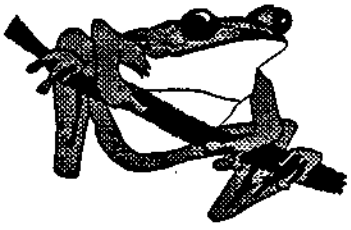
US Army Corps of Engineers

What's Living In Our Water?

- A Stream Study

INTRODUCTION

Water, a resource we all need. Every living thing on this planet relies on water for its survival. The water available for use by you and me is the same water that has been sustaining life on this planet for millions of years. Water constantly recycles itself. There is no new water being formed on the planet, so we must protect what we have! One activity of the Corps of Engineers is to monitor the water quality at its projects. A biological inventory is one way to monitor water quality. By seeing what lives in the water you have some idea if the water is clean. Concerned citizens are working together with the Corps of Engineers to help. The Corps lakes are monitored by concerned volunteers who routinely check the aquatic life in the creeks and streams. From these biological inventories a broad view about the quality of water develops. These tests can detect both sudden changes and trends over time. Stream quality monitoring tests are one way that the public can get involved. We all need clean water, we also need people who are concerned about preserving this valued resource. This program can also be used as a demonstration for school science groups or for the public to emphasize the ways that water quality can be monitored.



OBJECTIVES

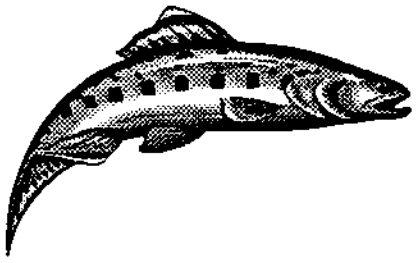
Participants will be able to: 1) identify several aquatic organisms, 2) define the habitat requirements for the organisms, 3) assess the relative environmental quality of a stream based on the number and diversity of species, 4) internalize care and realize importance of protecting water resources, 5) prompts action and involvement through monitoring and reporting of stream quality problems at Corps of Engineers projects

METHOD

A sample of the organisms living in a local stream is taken. From this sample an evaluation of the stream quality can be determined.

MATERIALS

four by four mesh seine (net), hand nets, magnifying glasses, several forceps, collection trays, thermometer, assessment forms, identification chart, clipboard, pencil, appropriate shoes and clothing



GRADE LEVEL

4-12 (can be adapted for younger age groups)
Also suitable for general public and college

SUBJECT

Science

GROUP SIZE

4-30 Groups larger than 10-15 are best done as demonstrations

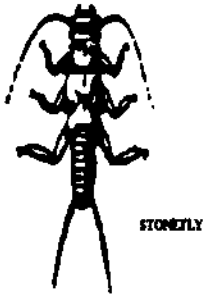
SETTING & SAFETY

This is an outdoor activity. A local stream with appropriate permission from a private land owner or government agency is required. The stream should be fairly shallow and small for safety reasons. During periods of high water a sample should not be taken. Powerful currents that are dangerous and unpredictable must be considered. The program should be conducted from late spring to early fall. The temperature of both the water and air must be determined. Do not enter a stream when the combined air and water temperature are less than 120 degrees F. Hypothermia, a condition caused by overexposure to cold, can result.

BACKGROUND

In streams the presence or absence of certain organisms relates a very telling tale. A sample of the macroinvertebrate life in the stream is taken. But first, what is a macroinvertebrate? Let's break down the word, so we may learn more about these stream dwelling organisms. The prefix "macro" comes from the Greek meaning large. Large? You'll need a magnifying glass to see some of these creatures! Large refers to the fact that you will be able to see them with the naked eye. Invertebrates are organisms that lack a backbone. Macroinvertebrate is a general classification of animals including aquatic insects and larvae, crayfish, clams, mussels, snails, and worms. Macroinvertebrates are excellent indicators of stream quality because they are

restricted to their immediate habitat and cannot escape the changes in water quality. Macroinvertebrates are also an important link in the food chain. Many other animals including snakes, turtles, fish and birds rely on the macroinvertebrates as a source of food. Macroinvertebrates are important to the overall health of the life in and around the stream.


STONEFLY

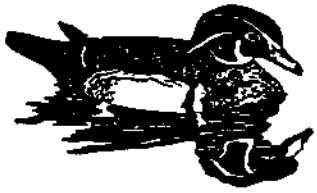
Water with abundant aquatic life is typically considered healthy. However, this may not be the case. The variety, number, and type of aquatic organism tell us how healthy or how clean the water is. For example dobsonfly larvae, stonefly nymphs, and riffle beetles can only survive in good quality water and are intolerant of pollution. Their presence indicates good water quality. Macroinvertebrates are classed into three groups: pollution intolerant, moderately tolerant, and tolerant. A sample with numerous pollution tolerant organisms can be the indicator of a problem with the water quality even though the number of organisms may be large. The optimum sample would contain a variety of intolerant and moderately tolerant organisms in large numbers.

PROCEDURE

Once a stream has been selected an appropriate area for sampling must be determined. Macroinvertebrates are typically found in riffle areas. The riffle area has high dissolved oxygen and abundant cover for the organisms to thrive. A riffle is characterized by a ripple in the water with an uneven stream bed. The composition of the stream bed should be varied with rocks ranging in size from 10 inch cobbles to small gravel. Once a riffle has been located you are ready to enter the stream. Be certain the seine is clear of any debris prior to entering the test area. The kick-seine method is used to gather the sample. An area measuring approximately 3' by 3' will act as the sample area. The seine should be outstretch and firmly placed in the stream bed, adjacent to the test area. The seine should be leaned at an angle facing downstream. Water should not flow above or beneath the seine otherwise organisms may escape. Be careful not to step in the test area. Every rock in the test area will be overturned and all organisms should be brushed downstream into the waiting seine. Examine each rock to be certain you have not missed any organism. Once all rocks have been removed and brushed, step into the test area and kick up the stream bed for approximately 60 seconds. Kick from the upstream edge of the test area toward the net. The bed should be disturbed to a depth of about two inches. Next, the seine should be scooped (without losing what you have gathered) and carried


CADDISFLY LARVA

onto shore. Once on the bank find a clear, flat, shaded area to examine the sample. Fill your collection trays with water then begin picking through the sample for organisms. Place anything that moves in the collection tray. Be careful as you pick through your sample, some organisms may be small. The magnifying glass and forceps may help. Identify and count everything in your sample. Students should be told how to minimize the impact on the sample site. All organisms should be handled carefully and returned to the sample site after the count is concluded. All rocks should be replaced as they were found, remember that moss grows on top of rocks. The form that is enclosed should be filled out as accurately and completely as possible. In order to get more meaningful results a number of tests should be repeated over time. Changes in the composition of the stream should be noted over the course of the months and years.



The program can be customized to fit the water quality concerns of the local Corps project. This program is easily used for public demonstrations, school programs, science curriculums, or for recruiting volunteers to assist with resource quality monitoring.

References

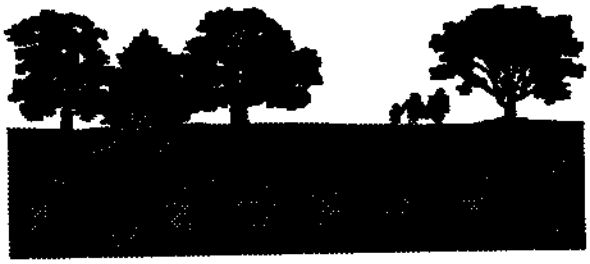
Caesar Creek Lake, U.S. Army Corps of Engineers, Ohio

Hamilton County Park District, Ohio

Little Miami, Inc., Ohio

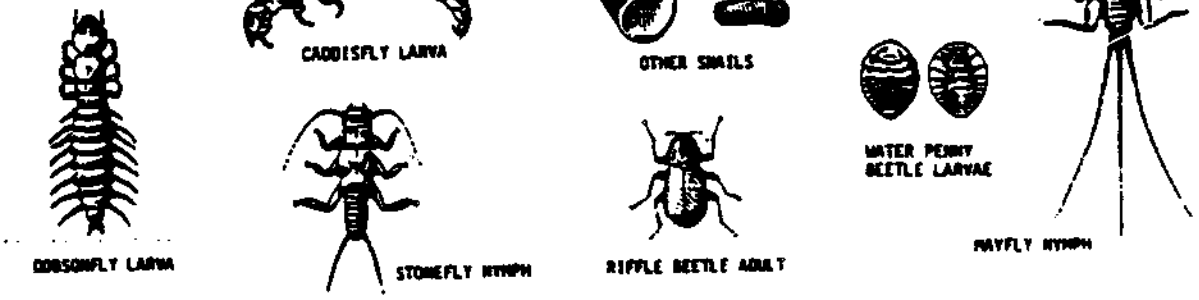
Ohio Department of Natural Resources, Division of Natural Areas and Preserves Scenic Rivers Program Stream Quality Monitoring

Western Regional Environmental Education Council Aquatic Project Wild

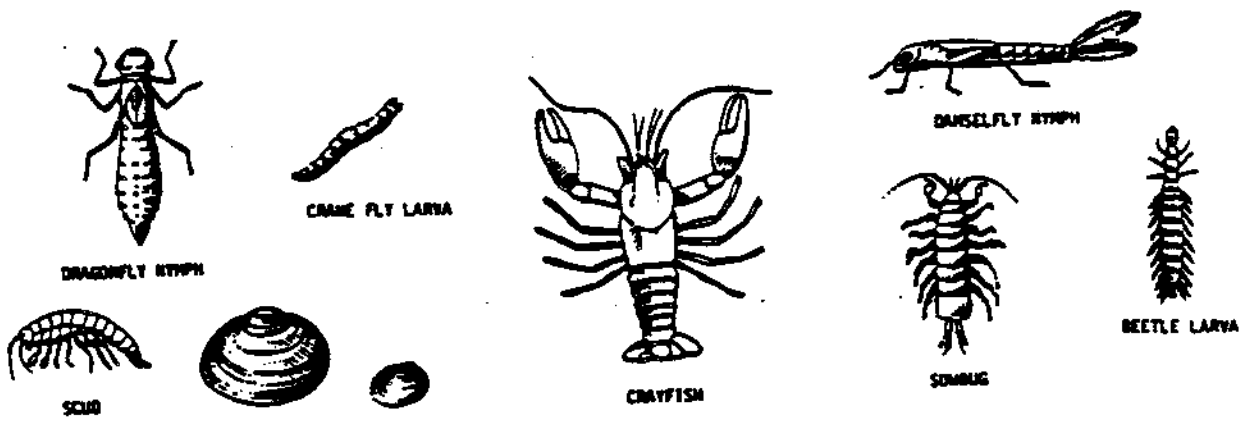


MACROINVERTEBRATE TAXA GROUPS

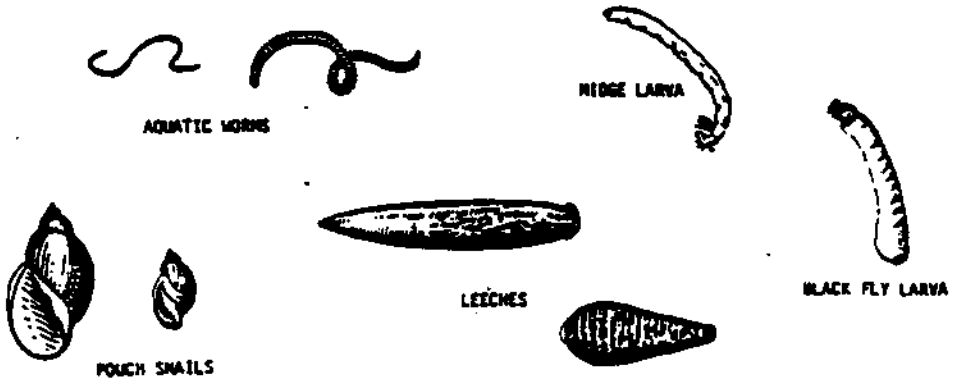
GROUP 1 (*These organisms are generally pollution-intolerant. Their dominance generally signifies* GOOD WATER QUALITY)



GROUP 2 (*These organisms can exist in a wide range of water quality conditions.*



GROUP 3 (*These organisms are generally tolerant of pollution. Their dominance usually signifies* POOR WATER QUALITY.)



STREAM QUALITY ASSESSMENT OBSERVATIONS AND ANALYSIS

The organisms on page 6 are grouped into three categories:

GROUP 1 (pollution-intolerant or good quality indicators)
GROUP 2 (organisms that can exist in both extremes of quality)
GROUP 3 (pollution-tolerant or poor quality indicators)

The organisms in these three groups are assigned a group index value.

GROUP 1 = **3** GROUP 2 = **2** GROUP 3 = **1**

The analysis procedure consists of counting the number of types of organisms in each category and multiplying the group index value.

EXAMPLE:	GROUP 1 TAXA		GROUP 2 TAXA		GROUP 3 TAXA	
	CADDISFLY(S)		DRAGONFLY(S)		BLACKFLY(S)	
	STONEFLY(S)		CRAYFISH		MIDGE(S)	
	MAYFLY(S)	3x3 = 9	CLAM(S)	3x2 = 6		2x1 = 2

The respective group index values are then added together to find the cumulative index value (which in the above case would be 17). By referring to the following chart, the stream quality assessment can thus be determined.

STREAM QUALITY ASSESSMENT	CUMULATIVE INDEX VALUE
EXCELLENT	23 and above
GOOD	17 - 22
FAIR	11 - 16
POOR	10 or less (SEE ACTION PROCEDURE ON PAGE 8)

NOTE: The organisms listed on the stream quality assessment form used in the field are to be recorded by placing a letter code in the corresponding block. Each letter represents your estimated count.

STREAM QUALITY ASSESSMENT OBSERVATIONS AND ANALYSIS

STREAM QUALITY IS RATED AS [POOR] IF:

(Suspect a toxicity or severe organic or physical problem)

GO TO ACTION PROCEDURE ON PAGE 8

a. Ninety percent or more of the organisms collected are taxa in GROUP 3 as shown on page 6.....

-OR-

b. You can differentiate only two kinds of organisms or less with the unaided eye.....

-OR-

c. One kind makes up 90% or more of the sample.

STREAM QUALITY IS RATED AS [MODERATE] IF:

(Suspect a mild physical or mild organic enrichment problem - actual source probably too difficult to pinpoint - no action recommended other than close monitoring)

a. Eleven to thirty percent of the organisms collected are taxa in GROUPS 1 and 2 as illustrated on page 6 .....

-AND-

b. You can discern three or more taxa, but less than six, with the unaided eye.....

-AND-

c. No one kind makes up more than 90% of the sample.

STREAM QUALITY IS RATED AS [GOOD] IF:

(No observable stream quality problems present - no action required)

a. More than 30% of the organisms collected are taxa in GROUP 1 as shown on page 6 .....

-AND-

b. You can discern six or more taxa from the collected sample.....

-AND-

c. No one kind makes up more than 50% of the sample.

STREAM QUALITY ASSESSMENT FORM

EXAMPLE EXAMPLE EXAMPLE

STATION RC14.6 STREAM Riffle Creek SAMPLE # 1

LOCATION 100 yards upstream of Riffle Creek Bridge

COUNTY Whitewater TOWNSHIP/CITY Rapids DATE 5-24-85 TIME 2:00 p.m.

GROUP OR INDIVIDUALS West Rivers High School Biology - 10th Grade NO. OF PARTICIPANTS 14

DESCRIBE WATER CONDITIONS (COLOR, ODOR, BEDGROWTHS, SURFACE SCUM, ETC.) Water was clear with no detectable odor. Bed had filmy green growth on some of the rocks. Small patches of white foam were observed below the riffles.

HACH KIT RESULTS (if used) AND OTHER OBSERVATIONS
D.O. 8.2 mg/l
pH 7.1

USE BACK OF FORM IF NECESSARY

WIDTH OF RIFFLE 12 ft.

WATER DEPTH 8 inches

WATER TEMP. (°F) 70

BED COMPOSITION OF RIFFLE (%)

SILT 10 SAND 10 GRAVEL (¼"- 2") 40

COBBLES (2"- 10") 40 BOULDERS (> 10") 0

MACROINVERTEBRATE TALLY

ESTIMATED COUNT LETTER CODE
A = 1 to 9
B = 10 to 99
C = 100 or more

GROUP 1 TAXA	LETTER CODE	GROUP 2 TAXA	LETTER CODE	GROUP 3 TAXA	LETTER CODE
WATER PENNY LARVAE	B	DAMSELFLY NYMPHS	A	BLACKFLY LARVAE	
MAYFLY NYMPHS	C	DRAGONFLY NYMPHS		AQUATIC WORMS	A
STONEFLY NYMPHS	B	CRANE FLY LARVAE		MIDGE LARVAE	
DOBSONFLY LARVAE	A	BEETLE LARVAE	A	POUCH SNAILS	
CADDISFLY LARVAE	C	CRAYFISH	A	LEECHES	A
RIFFLE BEETLE ADULT	B	SCUDS			
OTHER SNAILS		CLAMS	B		
		SOWBUGS	B		
NUMBER OF TAXA	6	NUMBER OF TAXA	5	NUMBER OF TAXA	2
(times) INDEX VALUE 3	18	(times) INDEX VALUE 2	10	(times) INDEX VALUE 1	2

CUMULATIVE INDEX VALUE: 30

STREAM QUALITY ASSESSMENT

EXCELLENT (> 22) ✓ GOOD (17-22) ☐

FAIR (11-16) ☐ POOR (< 11) ☐

PLEASE SEND THIS FORM TO:

SCENIC RIVERS COORDINATOR
OHIO DEPARTMENT OF NATURAL RESOURCES
SCENIC RIVERS PROGRAM

MACROINVERTEBRATE IDENTIFICATION GUIDE

GROUP ONE TAXA - pollution sensitive organisms

Caddisfly larvae

Order Trichoptera

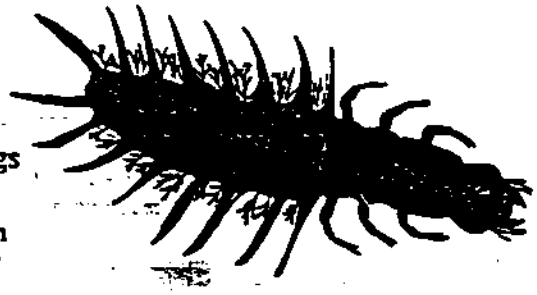
Key features:
- "worm-like" appearance
- 6 legs near head
- small tail hooks
- size range: 1/4" - 3/4"
- may be found in case

Caddisfly larvae can often be found on the undersides of stones, protected by a collection of small pieces of stone, shells, or other materials which are held together by an adhesive substance that caddisfly larvae secrete. They may also be found in cylindrical cases which they make and wear for protection. They will retract into this case when threatened or startled. Body color of these larvae varies from yellow and green to brown. Note: These larvae tend to curl up slightly (as pictured) when placed on a flat surface.

Dobsonfly larvae

Family Corydalidae

Key features:
- set of "pincers"
- tail hooks
- stout body with 6 legs
- lateral appendages
- with gills underneath
- size range: 3/4" - 4"

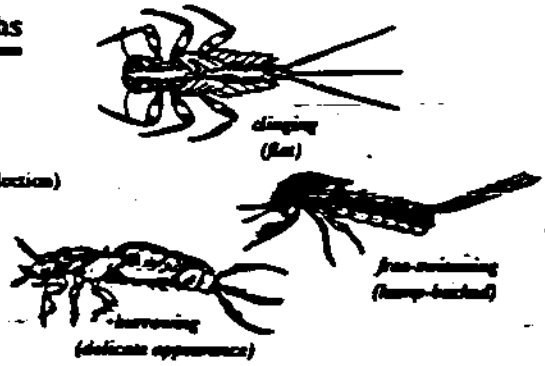


Dobsonfly larvae are often found clinging to rocks in the more swift areas of the riffle. These larvae are predacious and spend much of their time hunting for prey. They have stout bodies with tough skin. The appendages on the rear section of this organism are called "lateral appendages" and should not be mistaken for legs. If you find a dobsonfly larva in your seine, grasp it directly behind the head to pick it up. This makes it impossible for the larva to pinch you. Note: These larvae are also known as "hellgrammites."

Mayfly nymphs

Order Ephemeroptera

Key features:
- 3 hair-like tails
  (these may break off during collection)
- 6 legs
- 3 basic types
  (pictured at right)
- size range: 1/4" - 1"

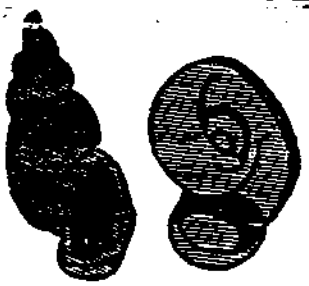


The three basic types of mayfly nymphs are classified by their life style. Burrowing nymphs burrow in the stream bottom sediments and are typically longer and lighter in color than the other types of mayfly nymphs. Clinging nymphs have very long, fragile tails, and are typically brown like the rocks they "cling" onto. Free-swimming nymphs are fast swimmers and are usually dark colored. Colors among these three groups vary, but tan, brown and black are common. All three types share the characteristic of three tails, though tail length may vary. Note: Tails are most easily seen on a submerged organism.

Other snails

Class Gastropoda

Key features:
- shell opens to the right
  (see text)
- on most, a covering, called the operculum, indicates the snail is alive. If no operculum is present look for a fleshy "foot."



Snails in this category can be distinguished from pouch snails by the opening of the shell. To identify a snail, hold it with the tip of the shell pointed up and the opening facing you (as pictured). If the opening is to the right side, you have a snail that falls in the "other snails" category, also referred to as the "gill-breathing" snails. Note: The flat, coiled snails also fall in this group. Do not count empty shells.

Water penny beetle larvae

Family Psephenidae

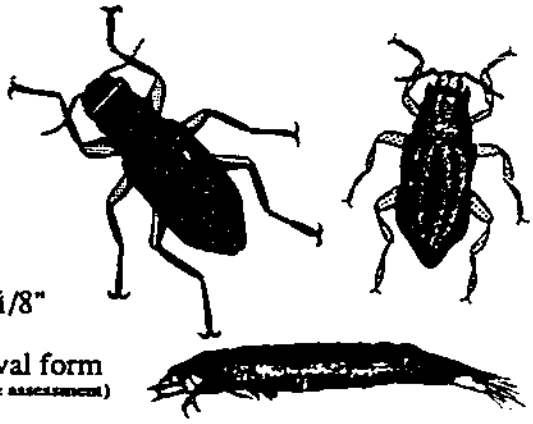
Key features:
- very flat
- oval or round in shape

Water penny beetle larvae look like fossils as they cling to the undersides of rocks. These larvae are tan, brown, or black and round like a penny (though smaller). They are flat and have six small legs on their undersides. They are best found by direct inspection of rocks at the river's edge.

GROUP ONE TAXA (continued)

Riffle beetles
Family Elmidae

Key features:
- very small
- 6 legs
- size range: 1/16" - 1/8"
- may be found in larval form
(this form is not counted in the assessment)



Riffle beetle adults are very small and hard to spot because they are dark colored (usually black) and blend in well with chips of slate and dead leaves in the seine. To find these beetles, watch the seine closely for movement. Be careful not to mistake small terrestrial beetles for riffle beetles. If you are uncertain if you have a riffle beetle or a terrestrial beetle, put it in water. If it seems well adapted to water and fits the rest of this description, it is probably a riffle beetle. Please be aware of the appearance of the larval form so you do not confuse it with other organisms. Note: the larval form's hard exterior, cylindrical shape and the small tuft of white filaments which are present at the rear of the organism.

Stonefly nymphs
Order Plecoptera

Key features:
- two tails
- 6 legs
- size range: 3/16" - 1"

Stonefly nymphs are structurally similar to mayfly nymphs, except that stonefly nymphs have two tails instead of three. They also appear somewhat less fragile than mayflies, because they possess a more rigid-looking exterior. They are often yellowish and brown or black in color and may be brilliantly patterned.

GROUP TWO TAXA - pollution intermediate organisms

Beetle larvae
Order Coleoptera

Key features:
- head more slender than that of the dobsonfly
- 6 legs
- some with lateral appendages
- size range: 1/2" - 1"

Beetle larvae look somewhat similar to dobsonfly larvae, but are generally smaller, lighter in color and more slender and tapered than the dobsonfly larvae. Often the head is darker in color than the rest of the body. Beetle larvae will not have the pronounced pincers that the dobsonfly larvae possess. The appendages on the back section (abdomen) of this organism, if present, are called "lateral appendages" and should not be mistaken for legs.

Damselfly nymphs
Order Odonata

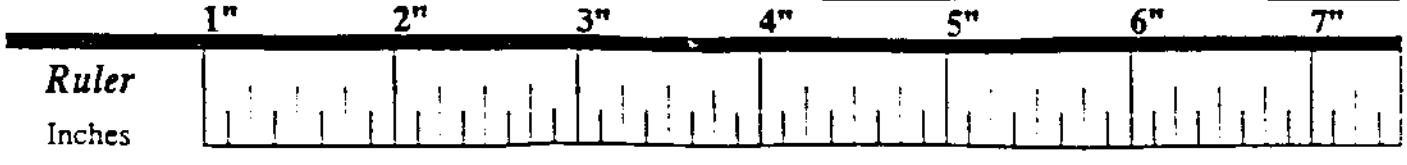
Key features:
- 6 legs
- 3 feathery tails
- size range: 1/4" - 3/4"

Damselfly nymphs are somewhat slender, with six legs and three feathery tail appendages which are flat or fan-like and usually oval in shape. These tails are readily visible if the organism is placed in water. Damselfly nymphs are most easily found around stream vegetation and calmer areas along the stream's edge.

Dragonfly nymphs
Order Odonata

Key features:
- large eyes (like adult dragonfly)
- 6 legs
- often flat on underside
- no tails
- size range: 1/2" - 1 1/2"

Dragonfly nymphs have the large eyes typical of the adult form and are often quite flat on their undersides. The abdomen may be stout and somewhat diamond-shaped. These nymphs do not have tails like those seen on the damselfly, mayfly, or stonefly nymphs. The body length may be up to 1", and the legs may be quite long. Some may look "spider-like". Like damselfly nymphs, they are most easily found near aquatic vegetation or in the calmer areas of the stream.

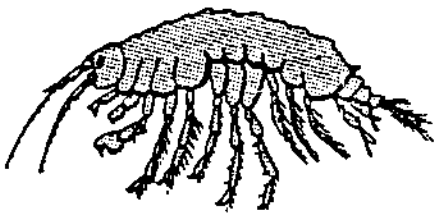


GROUP TWO TAXA – (continued)

Scuds

Order Amphipoda

Key features:
- "shrimp-like"
- usually quite small
- size range: 1/8" - 1/4"

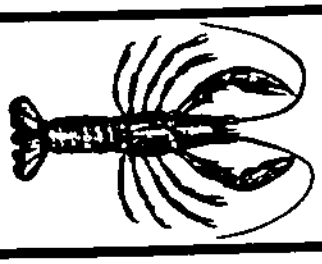


Scuds look basically like little shrimp and they actually belong to the same subphylum , Crustacea. They have a swimming motion similar to that of crayfish, propelling themselves backwards through the water with quick strokes of their tails. They may be slightly orange or green and are somewhat translucent and shiny with some silvery-gray coloration.

Crayfish

Order Decapoda

Key features:
- 10 legs, 2 with claws (unless broken off)
- size range: 1/2" - 5"



Crayfish are quite easy to identify. They closely resemble a small lobster. They can be found under loose rocks in the middle or the edge of the riffle. They will swim swiftly backwards if frightened or disturbed. Note: Crayfish are also known as crawdads.

Sowbugs

Order Isopoda

Key features:
- segmented, flat body
- many legs
- size range: 1/4" - 1/2"

Sowbugs are gray and segmented, with an "armored" appearance. They look very similar to terrestrial sowbugs, also known as pill bugs. They have a sort of rectangular shape and many small legs. Sowbugs are most easily found along the stream's edge.

Clams

Class Bivalvia (Pelecypoda)

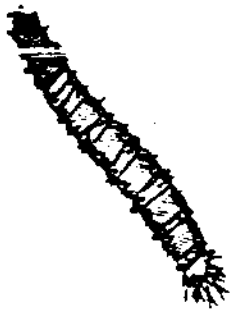
Key features:
- 2 hinged shells
- fleshy "foot" (not visible if shells are closed tightly)
- size range: 1/8 - 5"

Clams are easily identified by their two shells which they will draw tightly closed when handled. Count only whole, live clams (those with both shells) in your assessment. Please do not force the shells open to see if you have a live clam. If the shell is tightly closed, you can assume the organism is alive. Note: Clams are usually buried in the stream bottom, so you should kick up the sampling area thoroughly. Also, as indicated by the size range, clams can be quite small and fragile, so look carefully and handle carefully. Do not count empty shells.

Crane fly larvae

Family Tipulidae

Key features:
- worm-like and plump
- no legs
- small tentacles at one end (these will extend if you give the larvae a gentle squeeze)
- size range: 1/2" - 2 1/2"



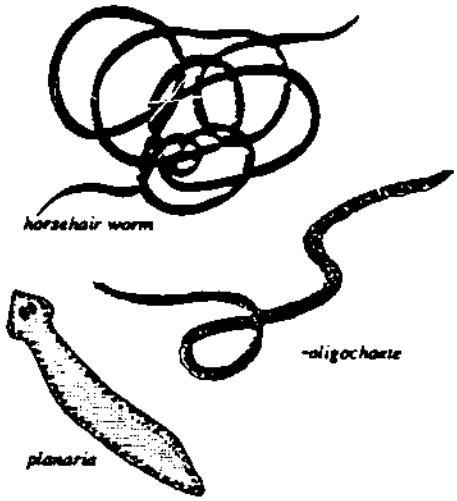
Crane fly larvae are segmented and worm-like. They can be found in a large variety of colors, including white, brown, and green. Some are almost translucent, so you can see the insides of the organism move when it crawls. These larvae have a soft, fleshy appearance and very short tentacles (small "arms" or projections) at one end which can be seen more easily if the larvae is placed in water or squeezed gently. They range in length from 1/2" to 2 1/2" and may be as thick or slightly thicker than a pencil.

Please note: If you find an organism which you cannot identify with this guide, please feel free to draw a sketch of it on the back page of your assessment form (please make a note on the front to direct our attention to the back of the page). We will then attempt to identify the organism at the office and contact you to let you know of the correct identification.

Aquatic worms

Phylum Annelida and others

Key features:
- no legs
- may be smooth or bristly
- may be round or flat
- size range: 1/4" - 5"

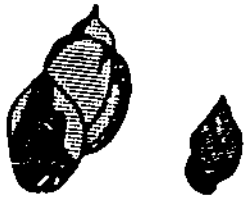


Many aquatic worms look similar to earthworms. In streams, you may also find very long, slender worms (such as horsehair worms), or flatworms, like planaria, which are small, sticky and soft-bodied (contrast with the muscular leech—see below). Many of these can slip through the seine quite easily, so watch closely. If you locate a worm and it is not a midge larva, crane fly larva, leech, or black fly larva, (see descriptions below and on previous page) it should be recorded under the category of "aquatic worms." These worms will typically "wriggle" in a snake-like fashion. Colors vary greatly in this category (red, white, and brown are common). Note: Worms do not have legs. If it looks like a worm, but has six legs (they may be small) it is not an aquatic worm — check the other descriptions to correctly identify the organism.

Pouch snails

Class Gastropoda

Key features:
- shell opens to the left
- presence of a fleshy "foot" indicates the snail is alive.

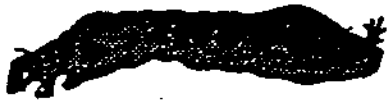


Snails in this category can be distinguished from "other snails" by the opening of the shell. To identify a snail, hold it with the tip of the shell pointed up and the opening facing you (as pictured). If the opening is to the left side, you have a pouch snail. Do not count empry shells.

Black fly larvae

Family Simuliidae

Key features:
- quite small
- bulbous at one end
- constricted in middle
- size range: 1/16" - 1/4"

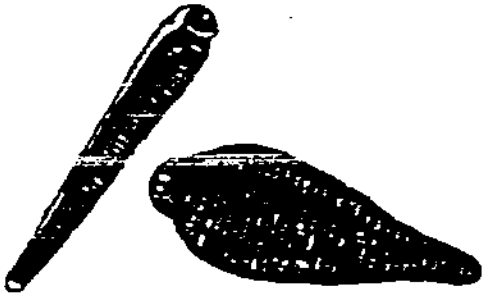


Black fly larvae are small and slightly bulbous at one end. They use this bulbous end to attach themselves to rocks and other material, usually in the faster flowing areas of the riffle. They may be found in groups, attached to stones and leaves and will often curl into a "s" shape when pulled off and held in the hand. Most larvae are gray or brownish in color.

Leeches

Class Hirudinea

Key features:
- flat underside
- circular, sucking mouth
- size range: 1/2" - 4" when extended (see text)



Leeches are usually small, dark in color, and flat. They tend to cling to smooth stones and boulders with their circular "sucker." Leeches generally have the appearance of being segmented, with the lines running perpendicular to the length of their body. They may be long and tapered, or short and tear-drop shaped. They move by extending and contracting their tough muscular bodies, so they may appear quite long. Do not confuse these with the flat, soft-bodied planaria (see above).

Midge larvae

Family Chironomidae

Key features:
- often very small, slender
- spastic squirming action (see text)
- size range: 1/8" - 1/2"

Midge larvae are often a distinct red color, though they can also be brown or even whitish in color. The best way to identify these larvae is by their small size and spastic squirming action. Note: These are very small, slender organisms, so watch your seine closely and make a point of inspecting leaves and other debris which may be present.

This identification sheet was designed by the staff of the Division of Natural Areas and Preserves with assistance from volunteer Anne Coburn for use with the Ohio Scenic Rivers Stream Quality Monitoring Program. Our thanks to Anne and to all our dedicated volunteers.

Natural Areas -Check Us!

ODNR

Division of Natural Areas and Preserves
Fountain Square • Columbus, Ohio 43224

SAMPLE

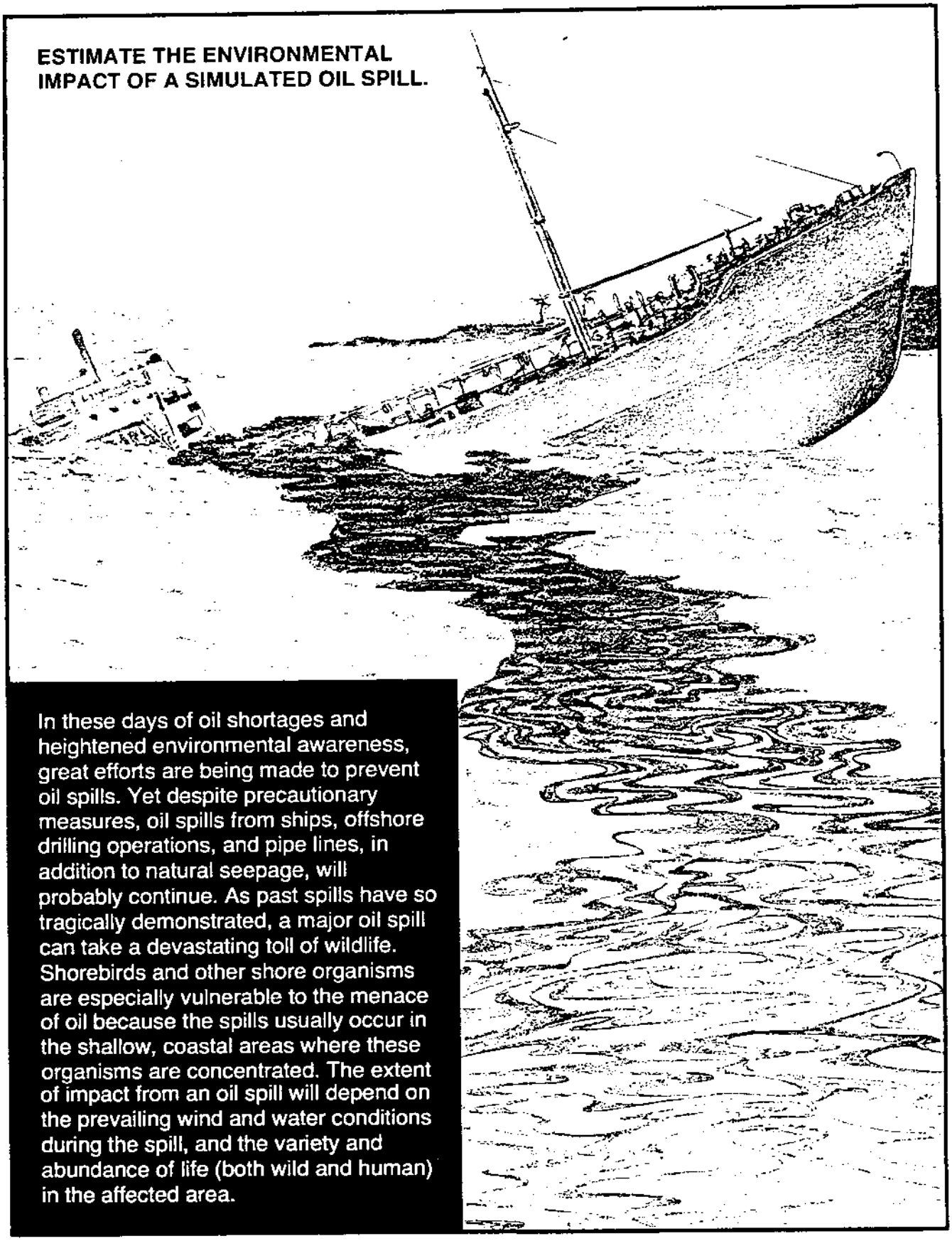
Stream Quality Monitoring Reports

DATE	WATER CONDITIONS COLOR	ODOR	BEDGRWOTH	SURFACE SCUM	TEMPERATURE (F)	INDEX VALUE	OVERALL RATING	COMMENTS
TRACE RUN 2/27/86	CLEAR	NONE	NONE	NONE	30	23.0	EXCELLENT	
5/17/86	CLEAR	NONE	MATLIKE	NONE	--	17.0	GOOD	
						AVERAGE 20.0	GOOD	
						STAN.DEV. 3.0		
TRACE RUN 2/13/88	CLEAR	NONE	STRANDS	NONE	70	2.0	POOR	H20 LOW
TRACE RUN 6/16/91	CLEAR	NONE	FILMY	WHITE FOAM	–	19.0	GOOD	
7/21/91	CLEAR	NONE	COTTONLIKE	NONE	__	20.0	GOOD	
						AVERAGE 19.5	GOOD	
						STAN.DEV. 0.5		
TRACE RUN 4/18/92	CLEAR	-----	------	—	60	17.0	GOOD	
6/29/92	CLEAR	NONE	SOME MOSS	NONE	65	20.0	GOOD	
7/11/92	MUDDY	NONE	SOME MOSS	MINOR	--	20.0	GOOD	
8/26/92	CLEAR	NONE	SOME ALGAE	—	72	25.5	EXCELLENT	
						AVERAGE 20.5	GOOD	
						STAN.DEV 2.9		

The following **OBIS OIL SPILL** activity is taken from Outdoor Biology Instructional Strategies (OBIS), Lawrance Hall of Science, University of California, Berkeley, California, and is used with permission.

OBIS OIL SPILL

ESTIMATE THE ENVIRONMENTAL IMPACT OF A SIMULATED OIL SPILL.



In these days of oil shortages and heightened environmental awareness, great efforts are being made to prevent oil spills. Yet despite precautionary measures, oil spills from ships, offshore drilling operations, and pipe lines, in addition to natural seepage, will probably continue. As past spills have so tragically demonstrated, a major oil spill can take a devastating toll of wildlife. Shorebirds and other shore organisms are especially vulnerable to the menace of oil because the spills usually occur in the shallow, coastal areas where these organisms are concentrated. The extent of impact from an oil spill will depend on the prevailing wind and water conditions during the spill, and the variety and abundance of life (both wild and human) in the affected area.

You might want to do *What Lives Here?* (I) or *Flocking to Food* (II) to introduce the youngsters to the organisms in your site before you tackle this activity.

In this activity, youngsters create a simulated oil spill with popcorn and estimate the environmental impact of the artificial disaster. (You can substitute dry leaves, sawdust, or wood shavings for the popcorn.) The kids pretend to be environmental experts who have been rushed to the scene of an "oil spill" to estimate its impact.

The group is divided into buddy teams (pairs) and one or two buddy teams are assigned to each of the following impact areas: landscape, plant life, animal life, and human activities. The teams work on the assumption that anything the popcorn touches will be covered with oil.

MATERIALS

1 "Popcorn Slinger" (see equipment card in the *OBIS Toolbox* folio)
20 liters of popped corn (another 20 liters will be needed for the FOLLOW THROUGH; see PREPARATION for source)

PREPARATION

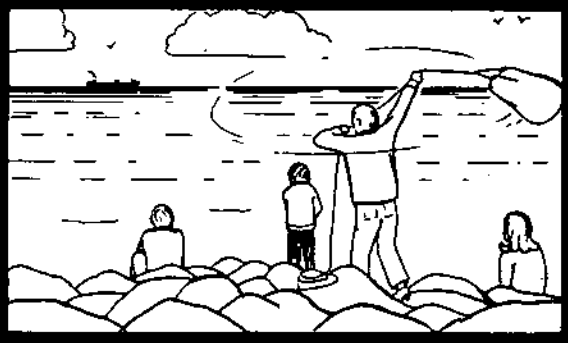
Site. Although this activity was developed at the seashore, you can also conduct the activity at a lake, river, or stream. Reduce the amount of popcorn for smaller bodies of water. The activity will be more exciting if you choose a site with strong dispersal features (water currents, wind, etc.) and an abundance of life. Breakwaters or docks are convenient places from which to toss popcorn into the water. For inland waters where oil spills rarely occur, you can simulate a toxic chemical discharge from an industrial or agricultural source.

Safety. The buddy system is a good safety precaution. OBIS does not suggest going into the water, but cold water, large waves, strong currents, and slippery rocks dictate that safety be a prime consideration. Find out who the nonswimmers are and keep a particularly close eye on them.

Popcorn. You can usually obtain stale, popped corn free of charge or for a nominal fee from popcorn concessionaires. Look under "Popcorn" in the Yellow Pages. If you cannot obtain stale popcorn, pop a two-pound bag of corn, which makes about 24 liters.

ACTION

1. At the activity site, quickly outline the activity. Explain to your group of environmental impact experts that they are responsible for estimating the impact of the spill on (a) the landscape, (b) the plant life, (c) the animal life, and (d) human activities. Divide the group into buddy teams and assign one to two teams to each of the above areas by handing out Impact Challenge Cards. Remind the teams to work on the assumption that anything the popcorn touches will be covered with oil.
2. Before you toss out the popcorn, ask the teams to predict in which direction the spill will move and how long it will take to reach the shore. Select a buddy team with a wristwatch to measure the time it takes for the spill to reach the shore or other reference point.
3. Toss out the popcorn and let your environmental experts begin their impact investigations.



4. Join in and follow the movement of the spill with the rest of the group.

SLICK TALK

Near the end of the alloted time or after the spill has been thoroughly dispersed, gather the teams together to report their impact findings on (a) the landscape, (b) the plant life, (c) the animal life, and (d) human activities.

Some impact questions to consider:
☐ How quickly did the spill reach the shore?
☐ What agents dispersed the spill? (Wind, tide, etc.)
☐ How might different wind or water conditions affect the spill?
☐ How could an oil spill be prevented from spreading?
☐ Who should be responsible for cleaning up the spill?

OBIS OIL SPILL
Impact Challenge Card #1

Outdoor Biology Instructional Strategies

Landscape. Follow the spill and estimate its impact on the landscape. Use a 25-meter length of twine to measure the area the spill covered.

Estimates: Water____sq. meters (length times width)
Land____sq. meters (length times width)

Where did most of the popcorn end up? Why? How might the underwater landscape be affected? How did the spill change the general appearance of the landscape?

OBIS OIL SPILL
Impact Challenge Card #2

Outdoor Biology Instructional Strategies

Plant Life. Follow the spill and estimate its impact on plant life.
How many different types of plants were affected?
Which plants were hardest hit by the spill? Why?
How might an oil spill affect land plants?
How would animals that eat aquatic plants be affected?

OBIS OIL SPILL
Impact Challenge Card #3

Outdoor Biology Instructional Strategies

Animal Life. Follow the spill and estimate the impact of the spill on the animal life.
How many different types of animals were covered with oil?
Which animals were hardest hit by the spill? Why?
Which animals do you think would be capable of escaping from a spill? Which animals might not be able to escape?
How might an oil spill affect animals that live under rocks in the water?

OBIS OIL SPILL
Impact Challenge Card #4

Outdoor Biology Instructional Strategies

Human Activities. Follow the spill and estimate its impact on human activities.
How might an oil spill affect fishing and other recreation activities such as swimming, water skiing, surfing, diving, etc?
How might boats, docks, breakwaters, and other water structures be affected?
How might drinking water or food be affected by an oil spill?

FOLLOW THROUGH

Try creating another "oil spill" under different conditions (outgoing versus incoming tide, windy versus calm day) or in a different site (river versus lake, ocean versus lake, one side of a breakwater versus the other side, etc.). Compare the effects of the second spill with those of the first.

Try different methods of containing an oil spill.

FURTHER INVESTIGATIONS

	Set
Water Breathers	*II*
Trail Impact Module	*Module*
Too Many Mosquitoes	*II*
Great Streamboat Race	*I*

Outdoor Biology Instructional Strategies
Lawrence Hall of Science
University of California
Berkeley California

Supported by a Grant from the National Science Foundation

EXHIBIT IV

SAMPLE POST-SITE VISIT ACTIVITIES

and

JUNIOR RANGER PROGRAM

The following activity is from Slippery Rock Area School District's "Interdisciplinary Environmental Education Handbook" and is used with permission from its author Carl Hursh.

E C O N O M I C S

CONCEPT: ENVIRONMENTAL DECISIONS

UNDERSTANDING: People most often affected by environmental abuses may be the least able to bring about effective action to correct them.

SKILLS: RECOGNIZING ENVIRONMENTAL PROBLEMS, VALUE FORMING SKILLS

MATERIALS: Paper, Pencil

TIME: 45 Minutes

FLOOD PLAIN MANAGEMENT

Several thousand communities across the country are flood-plagued. They are vulnerable because they are developed upon the flood plain of an adjacent waterway.

Flood plain management can reduce the potential flooding hazard. Zoning regulations can limit development on the flood plain. Waterways may be modified to alleviate potential flooding. Such measures include the construction of dams and reservoirs, the improvement of the channel, the creation of high-flow diversions and the construction of levees.

The Conemaugh River was modified after the floods of 1896 and 1936. Johnstown was considered to be flood-proof before the devastating flood on July 20, 1977.

QUESTIONS:

1. What advantages did the flood plains offer the early settlers?

2. Is it more economically feasible to move the water than to move the development?

3. What effect does flood insurance have on development and redevelopment?

4. What are some values of open space, particularly on the flood plain?

5. What problems can be anticipated with the relocation of people, businesses, factories?

The following activity is from Slippery Rock Area School District's "Interdisciplinary Environmental Education Handbook," and is used with permission from its author Carl Hursh.

M A T H E M A T I C S

CONCEPT: ECOSYSTEM

UNDERSTANDING: Each person in our society uses water every day. Some may abuse the use of our water supply. This abuse of water has an impact on the earth's resources.

SKILLS: Basic math skills

MATERIALS: Measuring cups, water faucet, pater, pencil

TIME: 15 minutes a day for 1 week

WATER CONSERVATION

Each person uses and abuses the natural resource of water. Whether a person uses it correctly or abuses it, the use has a definite impact on the earth.

Have the class as a whole adjust a water faucet to drip at a slow steady rate. Have the students collect and measure the water at a fixed interval. Continue this procedure for five days.

After a weekly tally has been taken, multiply this tally by 100, considering that there are 100 leaky faucets in the community.

Tally X 100 = ? Water wasted by the community.

Discuss what consumers can do to reduce water waste in the home, the school, and at work.

QUESTIONS:

1. What is the cost of a gallon of drinking water in your community?

2. Can we afford to waste the clean water in our community?

NOTES:

_____

_____

The following activity is used by permission of Pennsylvania State Parks. This activity can be used for a pre, on, or post-site visit.

NOLDE FOREST STATE PARK
ENVIRONMENTAL EDUCATION CENTER
R.D. # 1, BOX 392
READING, PENNSYLVANIA 19607

ACTIVITY 651 **PAGE** 4

LEARNING EXPERIENCE: Rainy Day

CURRICULUM AREAS : Science
Language Arts

GRADE LEVEL : Kindergarten
1st
2nd
3rd
4th
5th
6th

CONCEPTUAL THEME : Rain is important for plant and animal life.

OBJECTIVES

After completion of activity, students should be able to:

1. Describe the patterns made by falling raindrops.

2. Describe rain in terms of sound, feel, and effects on color.

3. Name some things you can observe on a rainy day which could not be observed on a clear day.

4. Describe the way differing surfaces react to water.

UNIT CONCEPT

1. Rainy days are cold and wet.

2. Animal and bird activity is reduced during rainy periods.

3. Rain drops vary in size and shape.

4. Rain changes the color, texture and smell of things.

5. Rain collects in puddles and streams.

FIELD ACTIVITY

Where does rain come from? Does the rain come straight down? Slant? Curve? What might cause this? Where does the rain go after it lands?

What color is rain?
How does rain affect other colors? Examine lichens and algae on wet and dry portions of tree trunks. Note the blacktop, the walls and roof of dry portions of tree trunks. What color is a rain drop? On a branch? On a leaf? On a flower? In the air? Bouncing out of a puddle? Falling through the air? Hanging on a branch? On a leaf? On grass? Look through a rain drop hanging on a branch. Describe what you see. Count the seconds between the time a raindrop falls from a branch until another one collects in the same spot and falls. Compare your raindrop count with that of a friend counting raindrops on another branch. Whose raindrops drop faster? Why?

Do raindrops always collect at the same place on a branch? Why do they collect where they do? Are all the raindrops on your branch the same size when they fall? Measure the length and width of your raindrop. Is it easy to get an exact measurement? Why or why not? What precautions must you take? Find the biggest raindrop you can and measure it. Find the smallest. Is there a relationship between raindrop size and how often they fall from a branch?

Look at the surfaces of different kinds of leaves, such as mayapple, violet, garlic jewelweed, different grasses, solomon's seal, holly, beech, maple (or whatever variety of leaves are common and in season). Count the raindrops on several leaves. Do the raindrops affect the leaves or plants in any way? Do they look wet? Do they feel wet? Are some wet all over or just in spots? What spots? Be sure to look at a leaf from several angles. Does there seem to be a characteristic texture to leaves that are wet just in spots? Try to describe what you feel. Have you ever spilled water and watched it bead in spots only? Where did that happen? What reasons can you think of that might cause some leaves to be wet in spots only? Are your explanations really facts or are they inferences? NOTE: Take time for the group to share their opinions on this subject and to evaluate them.

Turn some of the leaves over and observe how the rain "wets" the underside. Does the leaf's underside react the same as the leaf's upper surface? Does the underside look the same as the upper surface? Does it feel the same?

Can you find any leaves with "down" on them? What do you notice? How do these leaves look in the rain? How do they feel?

How do plant and leaf shapes shed or hold water? What happens to the rain that falls on the leaves of different plants?

Find some plants that are in bloom. Are the flowers open or closed? Why might this be?

Can you find some things that look dry but are wet?
Can you find some things that look wet but don't feel wet?
Can you find anything that is dry? Why is it dry?

Feel the dead leaves on the ground. Are they wet? How would you describe the feel of the wet leaves? Try to find some dry dead leaves. Do they feel the same as the wet ones? Do wet dead leaves feel the same as wet living leaves?

Listen to the rain on your raincoat, rain hat (umbrella, poncho, or whatever it is).
stand in the woods and listen; stand in the open and listen. Do all rain drops sound alike? Do you hear as many in both places? Describe the differences. What seems to cause the differences in sound? Can you hear rain more easily in the woods or out in the open? Listen to the rain falling on the ground in the woods. On the grass; on the path. Listen to the rain falling on the pond, stream, and in a puddle. Try to describe what you hear. When do you hear rain? Is what you hear rain or wind?

Can you smell rain? How do these things smell when they are wet: The path, the grass, different bushes and flowers, tree bark, dead leaves, the earth, your raincoat?
What does rain taste like. Does rain that falls on your tongue taste the same as a raindrop you catch from a branch?

What do animals do in the rain? Look for spider webs. Are they wet? All over? Is the spider in them? Does the spider look wet? Look for insects. Do they look wet? Where are they? What do they seem to be doing?

Do you hear any birds? Are they noisy? Quiet? Do you see any birds? Where are they? What do they seem to be doing? What kind of shelter do you suppose they find. Watch for rabbits, squirrels, groundhogs. Do you see many? What are they doing? Do they look wet?

If you are near a pond or a large puddle

Are there reflections in the pond today? What color is the pond during rain? Is all the surface the same color? the same texture? What geometric shape does rain make when it falls on the pond? What happens to this "shape"? Throw a pebble into he pond. Does the water look the same when the pebble hits it as when the raindrops hit it? Describe the similarities and the differences. Do you think all the raindrops falling on the pond are the same size? Why do you say this? If you have been to the pond before, at this time of year when it wasn't raining, do you notice any differences in the animal activity you see today?

Is the drop that you see bounce up the same drop that fell into the puddle? What makes you think so? What happens when a raindrop hits the puddle? Describe what you see.

Find some more puddles. Do you find more puddles on the driveway, on the grass, or on the path?

What is the surface of the earth like where you find the puddles? What covers it? Is it flat? Sloping? What is the area around it like? Compare the height of the area around it with the area where the puddle is. How does it feel when you walk on it?

Guess why puddles form where they do and not in other areas. Think of any places near your house or near school where there are many puddles during a rain. How are those places like these places that have puddles?

Where does the rain go that doesn't go into the puddles? Where will the rain go if this puddle gets bigger? Where will the water in this puddle go when it stops raining? What good are puddles? Are puddles ever not good? Where? When? Do raindrops falling in a puddle look like raindrops falling on a pond? Do you think a pond is really a big puddle? Why?

JUNIOR RANGER PROGRAM

U.S. ARMY CORPS OF ENGINEERS

HUNTINGTON DISTRICT

Contact:
Valerie S. Krenicky
Muskingum Area Ranger
(216) 343-4661

Mailing Address:
Muskingum Area Office
P.O. Box 9
Dover, OH 44622-0009

JUNIOR RANGER PROGRAM

A. U.S. Army Corps of Engineers

1. Brief History
2. "Whole lot Proud" movie-22 minutes
3. Muskingum River Basin
4. Five Features of Flood Control Projects-slides

B. Field Project Visit

C. Water Safety

1. Myths That Can Drown You
2. Boating-Safety Equipment
3. Recommended Equipment
4. Activities:
   - Sink Fast
   - Five Situations

D. Forest Management

1. Trees:
   - 3 Main Parts
   - How to Identify
2. Tree's Role in the forest
3. Why Trees are Important
4. Forest Fire Control Measures

E. Wildlife Management

1. Definition
2. Goals of Corps
3. Habitat Requirements
4. Hunting Laws
5. Animal Research
6. Wall Mural

F. Environmental Protection

1. Natural Resources
2. Recycling
3. 10 Ways to Conserve Energy
4. Recycle Materials for Bird Feeders

U.S. ARMY CORPS OF ENGINEERS

1. History:

The Corps of Engineers was organized on 16 June 1775 as a part of the Continental Army. It's main purpose was to design and construct fortifications after the Revolutionary War, engineers were needed to survey the western frontier, Louisiana Purchase, and the only people qualified were military engineers.

During this period of western exploration, the Army engineers were busy in the east applying their skills to public works projects-roads, canals, railroads, bridges, river and harbor projects. In the early 1900's, the Corps became involved in the Panama Canal. The "Manhatman Project" of the Corps ended WWII. This research and development project produced the atomic bomb.

The Flood Control Act of 1917 finally provided the Corps with authorization to construct levees along the Mississippi and Sacramento Rivers for flood control purposes. The Flood Control Act of 1936 recognized recreation as a potential use.

2. "Whole Lot Proud" movie - 22 minutes

3. Muskingum River Basin System:

The Muskingum River Basin System has had a long history of flooding. A flood in March 1913 caused an estimated 14 million in damages to the basin.

As a result of that flood, several Muskingum basin communities had studied measures to reduce flood damages but they found that flood protection projects were far too costly to undertake independently. When President Roosevelt announced formation of the Public Works Administration in 1933 to assist recovery from the Depression by funding civil works projects, the Muskingum basin leaders saw it as an opportunity to gain federal assistance for their proposed flood control and conservation projects. They organized the Muskingum Watershed Conservancy District under the Ohio Conservancy Act of 1914.

With the cooperation of the Huntington District, the Muskingum Watershed Conservancy District prepared preliminary plans for flood control and conservation program. 14 flood control reservoirs were planned.

WATER SAFETY

1. Myths That Can Drown You
   A. A drowning victim will wave frantically while yelling for help.
      False. Breathing is the drowning victim's main concern. Signs of a drowning victim: arms thrash in a pattern like an upward breast stroke, causing him to bob vertically in the water. His head is tilted back. His mouth is open, but only rarely is he able to yell for help.
   B. Wait at least 30 minutes after you have eaten to swim.
      False. Overeating before any strenuous exercise is dangerous. A modest meal, however, fuels the body for exercise.
   C. If your boat capsizes, leave it and swim to the nearest shore.
      False. Most boats will not sink even when overturned. By staying with your capsized boat, you'll have something to hold onto to keep your head above water. You'll also be easier for rescuers to spot.
   D. A drunken person will sober up immediately when he hits the water.
      False. A person who is legally drunk would need at least 7 hours without drinking to get rid of the alcohol in his bloodstream. Alcohol affects both the muscles and the brain.
   E. Once under water, you have only four minutes to live.
      False. When the water is cold-below 70°F-the coldness could actually save your life. Cold water triggers an involuntary reaction which slows down metabolism and cuts oxygen needs. With proper rewarming techniques, a cold water near-drowning victim can be saved.

2. Boating Equipment
   A. Personal Flotation Devices
      Coast Guard approved
      Readily accessible
      In serviceable condition
      Proper size for person intended to wear
   B. Fire Extinguishers
      Readily accessible
      In serviceable condition
   C. Distress Signals
      Orange flag
      Flares
      Signal mirror
   D. Lights
      Port - red
      Starboard - green

3. Recommended Equipment
      Drinking water
      Spare clothing
      Foul weather gear
      Oars or paddles
      Tool kit & spare parts

3. Recommended Equipment (Con't.)
   Radio
   Bailing bucket
   First aid kit
   Flashlight or portable light
   Towline
   Boat hook
   Compass, lake charts
   Extra fuel

4. Water Safety Activities
   Title: SINK FAST (adapted from Smith Aquatic Safety Services)
   Objective: To make the public aware of the disadvantages of not putting on a PFD before a problem occurs.
   Procedure: The audience is reminded that 85% of drowning victims did not wear a PFD even though one was available, and a struggling non-swimmer usually drowns within 60 seconds. Four members of the audience are chosen to sit in chairs representing a row boat in front of the room. A PFD is placed under each chair. One PFD is very large, one very small, one is in poor condition, and one is an unapproved ski belt. All are turned inside out and tangled up. A large person is placed in the chair with the small PFD and a small person is placed in the chair with the large PFD. At a given signal the "boat" starts to sink and the participants are timed to see how quickly they can correctly put on a PFD. Very few can do so within 60 seconds but due to the improper fit, etc, the "victims" drown anyway. The presenter can discuss the obvious problems with improper fit, poor conditions, and improper wearing technique that all result from not putting the PFD on ahead of time.

FIVE SITUATIONS

A. What safety items do you need to take with you when you go boating?

B. You are playing volleyball on the beach. There are a few coolers and extra volleyballs nearby. You see someone in the water struggling. What life saving techniques can you use to save this person?

C. Two people are in a canoe; one falls out. What could you do to save this person from drowning? What is the safest way to board a canoe? Get something in the water as fast as possible that floats. The safest way to board is by going to the center of the canoe.

D. Before you go swimming, what should you know about the area?

E. You see someone in the water struggling; you swim out to the person. Is this a good idea? Can you think of other ways to save this person?

FOREST MANAGEMENT

1. Trees
   A. 3 main parts:
      Crown - consists of limbs and branches, including twigs, leaves, flowers and fruits
      Trunk - main stem
      Roots - serves two main purposes: anchor trees firmly and trees obtain food through their roots
   B. How to identify trees
      Leaves - size, shape, color, arrangement, vein patterns
      Fruits - size, shape, color, fleshly, dry
      Bark - color, thickness, roughness, smoothness, scaliness, patterns of ridges and furrows
      Buds - size, color, arrangement
      Twigs - color, leaf scars, hairy, smooth
      Flowers - color, size, arrangement

2. A Tree's Role in the Forest
   Alive or dead, a tree is the center of a vital forest world. A mature tree provides food for many forest animals. The tree also provides shelter for animals. Micro-organisms which harm the tree are also present. Fungus enters the tree through holes in its trunk. Aging tree provides homes for birds and small animals. Even in death, a tree plays an important part in the forest. The trunk is invaded by lichens, mosses, and fungi. A variety of insects and spiders make the decaying tree their home. Finally nothing is left of the tree but the rich organic material it returns to the soil. This provides energy for new life in the forest.

3. Why Trees Are Important
   Help reduce pollution
   Take in carbon dioxide and give off oxygen
   Provide shade
   Provide wind breaks
   Reduces chill factor
   Helps reduce noise
   Provides employment - furniture factories, mill workers, loggers, nursery workers, etc.

4. Forest Fire Control Measures
   Fire season can occur whenever conditions are right.
   Spring - March through May
   Fall - October through November

   Fire triangle = fuel, air and heat
   Remove any one element and fire will stop

   Fire behavior is influences by:
   A. Fuel
      Fuel moisture content
      Wet fuels burn poorly, if at all
      Size and shape
      Continuous/patchy fuels
   B. Weather
      Wind
      Humidity
      Temperature
      Last rainfall

C. Topography - lay of the land
Aspect - direction slope faces
Slope
Steeper the slope, faster fire burns
Position of the fire

Basic types of wild fires:
A. Surface - burns ground litter, logs, leaves, grass
B. Crown - burns tree tops, snags, branches
C. Ground - burns below ground level, duff, roots, soil

Fireline - scrap to mineral soil, eliminates fuel from triangle

Handtools and Equipment:
Fire rakes
Beaters
Water pumps

Two methods of suppression:
A. Direct attack
Close to fire
B. Indirect attack
Away from fire's edge
Use natural firebreaks, such as streams, rock cropping, etc.

WILDLIFE MANAGEMENT

Wildlife management: managing wildlife and its habitat, including man for the benefit of all the plants and animals in the environment.

U.S. Army Corps of Engineers Goal:

1. Encourage song birds
2. Attract mammals for visitor sighting

NOTE: Traditional wildlife management goals increase populations of game species for hunting purposes. Because of the location of houses to recreation areas, this is not possible.

Habitat- environment that supplies everything wildlife needs for life:

1. Food
2. Cover - needs protection while feeding, sleeping, loafing, breeding, nesting and traveling
3. Water
4. Living Space - overcrowding leads to less wildlife

Factors Reducing Wildlife:

1. Habitat Removal
2. Pollution
3. Dogs
4. Highways
5. Poaching
6. Mowers

Hunting Laws

1. Tool of wildlife management for helping to maintain healthy wildlife populations

    a. When there are too many animals in a given area, animals will die.
    b. Provides funding for wildlife management programs.

Principal Game Species

1. White-tailed deer
2. Cottontail rabbit
3. Fox and gray squirrel
4. Ruffed grouse
5. Bobwhite guail
6. Ring-necked pheasant
7. Wild turkey
8. Various waterfowl

Animal Research:

1. Have each student collect information regarding the animals habitat requirements - Food, water, shelter and living area.

LIST OF ANIMALS, BIRDS, REPTILES, ETC:

Chipmunk	Raccoon
White-tail deer	Cottontail rabbit
Gray squirrel	Striped skunk
Red fox	Mouse
Beaver	Muskrat
Opossum	
Bat	
Red tailed hawk	Wild turkey
Mallard	Blue heron
Great horned owl	Cardinal
Red wing blackbird	Mourning Dove
Turkey vulture	Ruby throated hummingbird
Woodpecker	Wood duck
Spider	Bluegill
	Small mouth bass
Box turtle	Trout
Black snake	Red-spotted newt
Grasshopper	American toad
Praying Mantis	Spring peeper
Luna moth	Honey bee
Tiger swallowtail	Paper wasp

2. After data is collected, have students create a wall mural. Include such features as forest, stream, farm land, pond, roads, open field, houses, etc.

AMERICAN TOAD
Habitat: Virtually anywhere there is moist shelter, food and water to breed i
Food: Includes beetles, aphids, flies, leafhoppers and caterpillars. It drinks from dew drops on plants.

BLACK RAT SNAKE
Habitat: Hardwood forest, swamps, farmland, old fields, barnyard.
Food: Small mammals, lizards, birds, mice, eggs.

BROWN BAT
Habitat: Cave areas, old houses, attics.
Food: Insects

EASTERN GRAY SQUIRREL
Habitat: Hardwood or mixed forests, urban and suburban gardens and parks.
Food: Eats almost anything that grows on trees including birds, leaves, flowers, seeds, nuts and cambium layer beneath bark. Also eats mushrooms, berries and others.

EASTERN BOX TURTLE
Habitat: Moist forested areas; wet meadows, pastures, flood plains.
Food: Earthworms, berries, mushrooms.

GREAT HORNED OWL
Habitat: Woodlands
Food: Small mammals- primairly mice, also takes rabbits, wood chucks, skunks and smaller owls.

HONEY BEE
Habitat: Meadows, open woods, gardens, fruit orchards, and croplands where flowering plants grow.
Food: Bees eat nectar, pollen and honey. A bee carries nectar to the hive in a special section of its stomach and carries pollen in "baskets" on its hind legs.

OPPOSSUM
Habitat: Moist woods, edges of streams or swamps, farms, cities and suburbs.
Food: Feeds at night on a variety of food including nuts, meats, eggs, insects, carrion and garbage.

PRAYING MANTIS
Habitat: Gardens, meadows and fields.
Food: Includes beetles, aphids, flies, leafhoppers and caterpillars. It drinks from dew drops on plants.

RED-TAILED HAWK
Habitat: Mainly deciduous forest and adjacent open country.
Food: Small rodents - mice, red squirrels, chipmunks.

RUBY-THROATED HUMMINGBIRD
Habitat: Suburban gardens, parks and woodlands.
Food: Nectar from red tubular flowers.

TIGER SWALLOWTAIL
Habitat: Broadleaf woodland glades, gardens, parks, orchards and along roads and rivers.
Food: Nectar from flowers.

TROUT
Habitat: Cold, clear streams.
Food: Insects, aquatic plants.

WHITE-TAILED DEER
Habitat: Farmlands, brushy areas and woods.
Food: Green plants including aquatic one in summer, eating acorns, beechnuts, other nuts and corn in fall, in winter, browsing on woody vegetation including twigs and buds of birch, maple and conifers.

WOOD DUCK
Habitat: Wooded swamps, rivers, lakes and ponds.
Food: On land, it feeds on wild grapes, berries, acorns, chestnuts, beechnuts, grasshoppers, crickets and spiders. On the water, it eats insects, small fish, frogs, tad poles, snails and water plants.

ENVIRONMENTAL PROTECTION

What were the three subjects that we've talked about during the Jr. Ranger program: water, forest, wildlife - natural resources.

Natural Resources - in a broad definition, natural resources includes everything that occurs naturally, either on or in the earth, that is useful to us.

Give examples of natural resources and things that aren't: water, plastic, air, minerals, paper.

Natural gas, is a fossil fuel like coal and oil, having been formed through long periods of time by the incomplete decomposition of plant and animal remains that had been covered for one thousand years by sedimentary deposits.

As you can see, it is very important that we use our natural resources with extreme care. We do not want to use up our supply. We must wisely manage and preserve our natural resources.

One of the things we can do is recycle. Through recycling, we can hopefully maintain our supply of natural resources.

What you can do: Recycle as much material as possible. Reduce the volume of trash by flattening cartons. When buying a few items, don't take a bag. Start a recycling plant or drive in your community.

Along with recycling, we can conserve energy. What does conserve mean. It means to avoid wasteful use of a natural resource. Let's think of five ways of conserving energy in your home or while in school.

1. Recycle paper, glass
2. Cut heat
3. Drive less or combine trips
4. Take a shower rather than a bath
5. Turn off lights when no one is in the room
6. Use less paper
7. Fix a leaky water faucet
8. Make sure toilet isn't leaking
9. Use washing machine only when have full load of clothes

Recycle "trash" items to make bird feeders.

RECYCLING MATERIALS FOR BIRD FEEDERS

Divide class into five groups:

1. Plastic milk carton
2. Cardboard milk carton
3. Detergent bottle
4. Bleach bottle
5. Coffee can with plastic lid

Have students bring in the above list of items.

Please have the following available to students:

Pliers - cut and shape wire
Knife or sharp-pointed scissors - cut plastic containers

U.S. ARMY CORPS OF ENGINEERS

CERTIFICATE OF ACHIEVEMENT

_____

HONORARY JUNIOR RANGER

Principles of Membership

I will help My Country and the Corps of Engineers by:

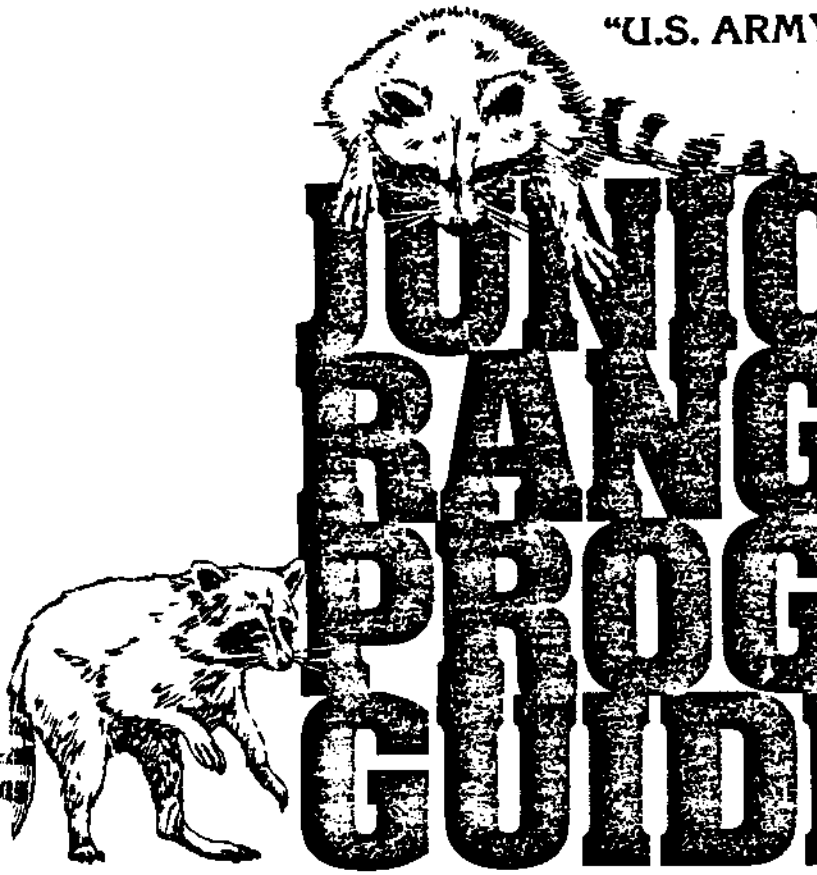
Preserving the Environment Within My Community and Away From Home by Never Littering: Keeping Clean the Forests, Fields, and Waters: Preventing Forest Fires: Respecting the Rights and Property of Others: Assisting the Rangers who Serve the Public and Protect Our Land and Natural Resources.

_____ _____

Date *Ranger, Corps of Engineers*

ENG FORM 4649, 1 APR 75

"U.S. ARMY CORPS OF ENGINEERS"



JUNIOR RANGER PROGRAM GUIDELINES

United States Army
Corps of Engineers

Nashville District

THE JUNIOR RANGER PROGRAM

1. References:

a. ER 672-2-1, "Honorary Junior Ranger Certificate Implementation" (Appendix A).

b. ER 310-1-1, "Public Information Fact Sheets"

2. Purpose - The purpose of this manual is to provide guidance and direction in implementing the Junior Ranger Program at US Army Corps of Engineers water resource projects.

3. Objectives of the Junior Ranger Program - The objective of this program is to develop in the young people who visit Corps of Engineers lakes an awareness of the environment and the role the Corps plays in managing this environment at the lakes, and to solicit their assistance in helping Corps rangers in serving the public and protecting our lands and natural resources. The program is designed to inform these young people about the Corps of Engineers, the Corps recreation and resources management programs, and the problems and challenges that land managers face in trying to provide outdoor recreation opportunities while properly managing our natural and cultural resources. The Junior Ranger Program should help develop in these young people an environmental ethic.

4. Policy

a. The Junior Ranger Program is not intended to be merely a reward for a single good deed.

b. The Junior Ranger Program should be a management tool and not merely an incentive to promote better public relations or as a "visitor courtesy."

c. The Junior Ranger Program should be available for young people in the age range of 6-12 years old. (Younger children who have not gone to school lack the social background to mix with older children. Children age 13 or older tend to shun this type of program as "kid's stuff.")

d. The Junior Ranger Program shall consist of a series of interpretive programs and activities, conducted by a ranger or park technician, covering the subject areas of "The Corps Ranger," Environmental Protection," "Wildlife Management," "Forest Management," and "Water Resources."

e. To qualify as a Junior Ranger, candidates must successfully complete the activity or activities in each subject area to become exposed to the following concepts:

(1) The Corps Ranger - "The Corps ranger protects and manages the natural and cultural resources of the lakes, and looks after the well being of lake visitors."

(2) Environmental Protection - "We all must do our part to improve the quality of the environment and conserve our energy resources."

(3) Wildlife Management - "All wildlife is essential to the web of life, and provides us with many economic and social benefits. Wildlife should be protected and properly managed."

(4) Forest Management - "Forests, if properly managed, can provide us with multiple benefits, including recreation, wildlife habitat, wood products, watershed protection, and aesthetics."

(5) Water Resources - "Corps of Engineers lakes and other waters are used not only for transportation and water supply, but also for recreation. We should not pollute our waters. We must constantly practice water safety when we swim and boat in these lakes."

f. Candidates for Junior Ranger may complete these requirements at one lake, or at several different participating lakes.

g. Upon completion of the program, the Junior Ranger will be awarded a Certificate of Achievement (ENG Form 4549 - See Appendix B) and an embroidered patch (see Appendix C). Signature of the resource manager or ranger on the certificate should be handwritten to enhance its value.

5. Implementation

a. Each Junior Ranger candidate will be furnished a Junior Ranger application and record card (Appendix D). Youth leaders will be furnished a brochure (Appendix E) to inform them of the objectives of the program.

b. The District Engineer may requisition embroidered patches from the Leonard Corporation, 323 E. Allegheny, Philadelphia, Pennsylvania (specify the Junior Ranger patch developed for the Nashville District in 1978), and the certificates from OCE Publications Depot, Alexandria, Virginia 22304.

c. Resource Managers will develop specific interpretive programs or activities for each of the five subject areas: "The Corps Ranger," "Environmental Protection," "Wildlife Management," "Forest Management," and "Water Resources."

d. Resource Managers will publicize the Junior Ranger Program through the various media to increase local awareness and build community support.

e. Once designated as Junior Rangers, these young people should not be forgotten, but should be encouraged to live up to their pledge of "Assisting Corps rangers in serving the public and protecting our lands and natural resources." The Resource Manager should maintain a roster of Junior Rangers and involve these young people in further Junior Ranger activities. For example, the Resource Manager may wish to occasionally call upon them for

conservation projects, or special Junior Ranger get-togethers. The Junior Rangers in one area may wish to meet together monthly, or work together on a nature trail.

f. The District Engineer will periodically publish and send to each Junior Ranger a "Public Information Fact Sheet," written on a third grade reading level, with items of interest to the Junior Rangers. Items might include:

(1) New Junior Rangers

(2) Energy Conservation Tips

(3) Wildlife Notes

(4) Water Safety Information

(5) Announcement of Activities at the Lakes

(6) Information About Current Conservation Issues

(7) Nature Games or Crossword Puzzles

(8) Cartoons

(9) Announcement of Junior Ranger Meetings

6. Junior Ranger Program Guidelines

a. The specific programs and activities in each of the five subject areas should be adapted and designed to meet the individual needs and characteristics of the local lake and its young visitors. The activity or activities for each subject area might consist of one or more of the following:

(1) Talks

(2) Films

(3) Conservation/Service Projects (litter pickup, tree planting, trail work, build bird boxes, etc.).

(4) Eassay or Poster Contests

(5) Campfire Programs

(6) Environmental Games or Crafts

(7) Guided Tours

(8) Directly Assisting Ranger in His/Her Work.

(9) Recreation Activities (canoeing, camping, fishing, etc.).

(10) Nature Oriented Activities (acclimatization, web-of-life, trail walk, etc.).

(11) Eco-Meet.

Programs should be interpretive in nature and involve the out-of-doors. An example of a complete Junior Ranger Program is attached (Appendix F).

b. Particular emphasis should be given to school children, youth groups (Boy Scouts, Girl Scouts, day camps, etc.), and young children camping with their parents. Do not overlook the young people that live in the lake area--they may be the most productive candidates.

c. Programs and activities for each subject area should be approximately 1-1½ hours in length and offered on separate days. Following are three typical schedules:

(1) Programs presented at a nearby school (or scout troop meeting), one day per week for a five-week period.

(2) Program each day of the week for campers (in destination family campgrounds) or at an organized youth camp.

(3) Program on weekends or designated week day for area residents, conducted at the lake Visitor Center over a five-week period.

6 Encl
1. Appendix A, ER 672-2-1
2. Appendix B, Honorary Junior Ranger Certificate (ENG Form 4549)
3. Appendix C, Junior Ranger Patch Design
4. Appendix D, Junior Ranger Application and Scorecard (ORN Form 500)
5. Appendix E, Junior Ranger Brochure for Youth Leaders
6. Appendix F, Sample Junior Ranger Program

APPENDIX A

DEPARTMENT OF THE ARMY
Office of the Chief of Engineers
Washington, D. C. 20314

ER 672-2-1

DAEN-CWO-R

Regulation
ER 672-2-1

15 May 1975

Project Operation
AWARDS
HONORARY JUNIOR RANGER CERTIFICATE IMPLEMENTATION

1. Purpose. To provide Divisions and Districts guidance for implementing the Honorary Junior Ranger Certificate Award.

2. Applicability. This regulation applies to all Division and Districts having Civil Works responsibilities.

3. Background. The subject award was adopted on an experimental basis in the Kansas City District during the 1973 recreation season. Based on public response generally favorable to the program, it has been determined that the award will be implemented Corps-wide. District participation will be on a voluntary basis.

4. Action to be Taken. General guidelines for implementation of the award are stated below. Specific implementing instructions should be formulated by the District Engineer with Division concurrence.

a. A basic assumption is that the target audience for the award will be youngsters, generally ages 6-14, who have been observed by Corps resource personnel.

b. Particular emphasis will be given to school children and to youth groups (Boy Scouts or Girl Scouts) who voluntarily participate in community action project cleanup campaigns.

c. The award is not given merely as an incentive to promote better public relations or as a "visitor courtesy."

d. Signatures of the Resource Manager and/or the Resource Ranger should be hand written rather than preprinted to enhance the value of the certificate.

e. Advance publicity and media coverage will increase local awareness and build community support.

ER 672-2-1
15 May 75

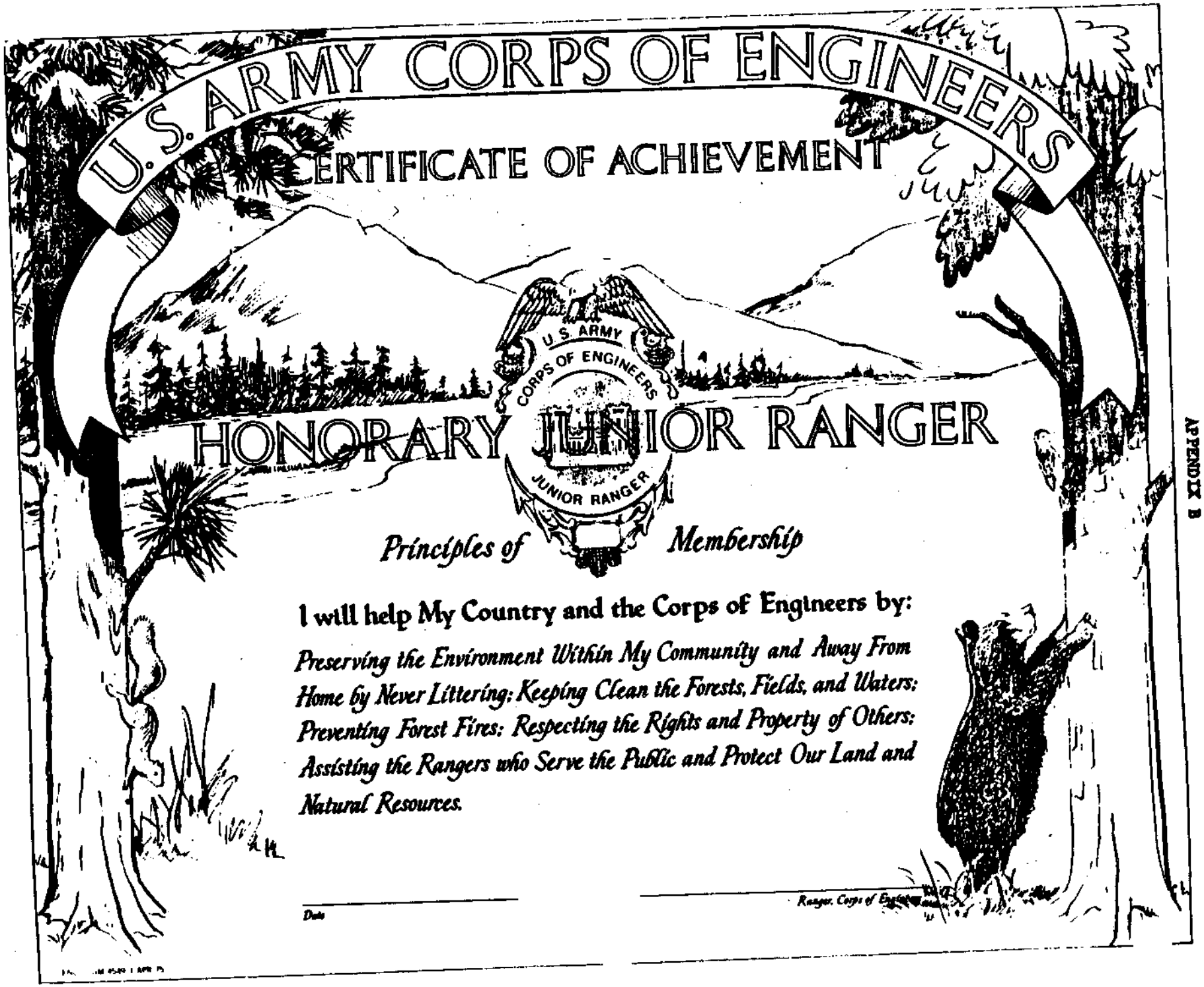
f. District Engineers will requisition the certificates (ENG Form 4549) directly from the OCE Publications Depot, Alexandria, Virginia 22304.

5. Objective Approach. This program can be an excellent technique for rewarding children who have performed good deeds at Corps recreation areas. Here is a management tool and an incentive for building in our youngsters those concepts fostering the premise not only, "The Corps Cares" but also, "People Care."

FOR THE CHIEF OF ENGINEERS:

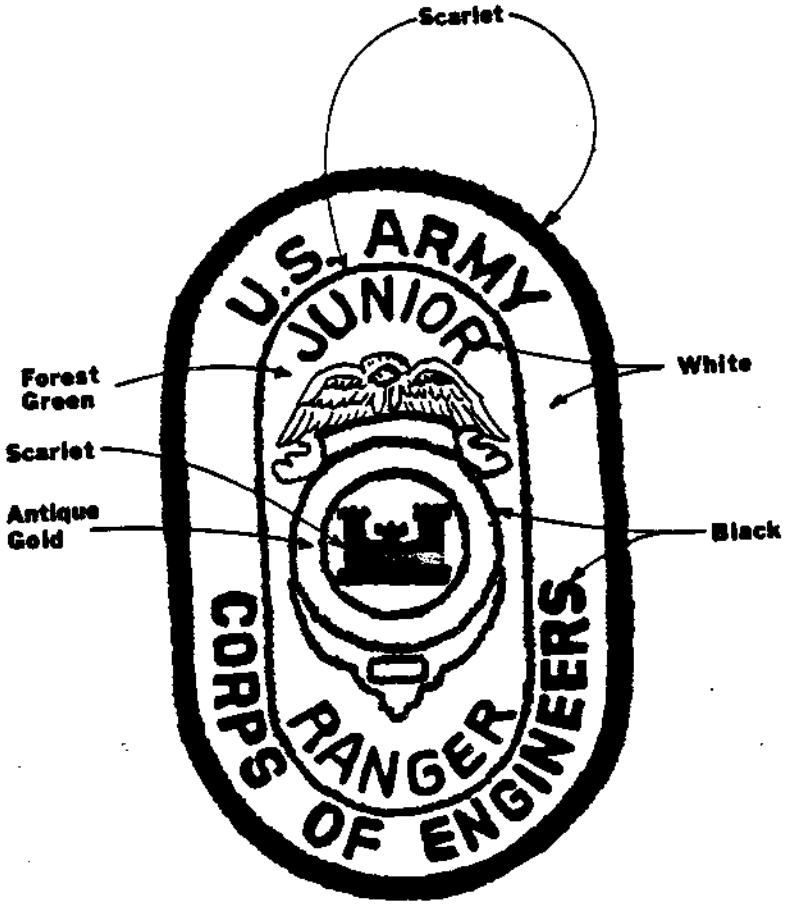
RUSSELL J. LAMP
Colonel, Corps of Engineers
Executive

DISTRICT ENGR	COMPT ✓	AUDIT	OFC SVC	CONST
DEPUTY DE	BUD	PAO	PROG DEV	ENGR ✓
EXEC ASST	F&A	COUNSEL	PERS 2	OPS ✓
[redacted]	MGT	SAFETY	SUP	RE


U.S. ARMY CORPS OF ENGINEERS
CERTIFICATE OF ACHIEVEMENT
U.S. ARMY
CORPS OF ENGINEERS
JUNIOR RANGER
HONORARY JUNIOR RANGER
Principles of Membership
I will help My Country and the Corps of Engineers by:
Preserving the Environment Within My Community and Away From Home by Never Littering; Keeping Clean the Forests, Fields, and Waters; Preventing Forest Fires; Respecting the Rights and Property of Others; Assisting the Rangers who Serve the Public and Protect Our Land and Natural Resources.
Date
Ranger, Corps of Engineers

APPENDIX C

Jr. Ranger Patch Design



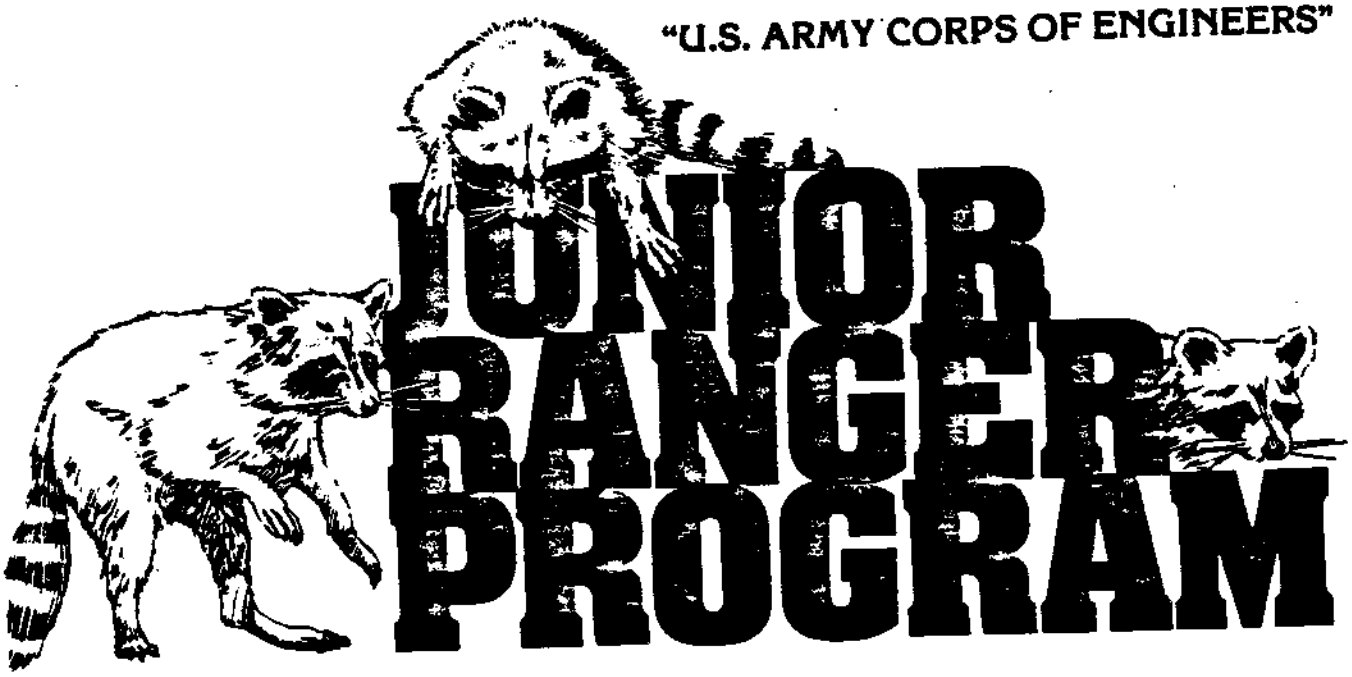
(Actual size)

How Do You Become A Junior Ranger?

Have you ever seen the world from an ant's point of view? Just what does a ranger do? Do you know when and where to plant a tree? If you are between the ages of 6-12, you can discover all this and more by joining the JUNIOR RANGERS! To become a member takes a little bit of time, but you have lots of fun.

The Junior Ranger program is sponsored by the U.S. Department of the Army, Corps of Engineers.

You can become a Junior Ranger by completing all the requirements at one lake, or by visiting different participating Corps of Engineers lakes. After completing the requirements, fill out the application and give it to a ranger. You will be awarded a patch and certificate. Wear the patch on your jacket to show everyone that you are an official Junior Ranger!



Application

Name _____ Phone _____

Address _____

City _____ State _____

Zip Code _____ Date of Birth _____

I have successfully completed the requirements, and request membership in the U.S. Corps of Engineers Junior Ranger program.

Date _____ Signature _____

ORNOP-R

ORN FORM 500
December 1977

Junior Ranger Requirements

1. How old can I be to qualify? 6-12 years old
2. How long may I take to complete the requirements? 1 year
3. I have participated in the following programs (don't forget signatures):

Subject Area	Date	Signature of Ranger	Program Title	Lake
The Corps Ranger				
Environmental Protection				
Water Resources				
Forest Management				
Wildlife Management				

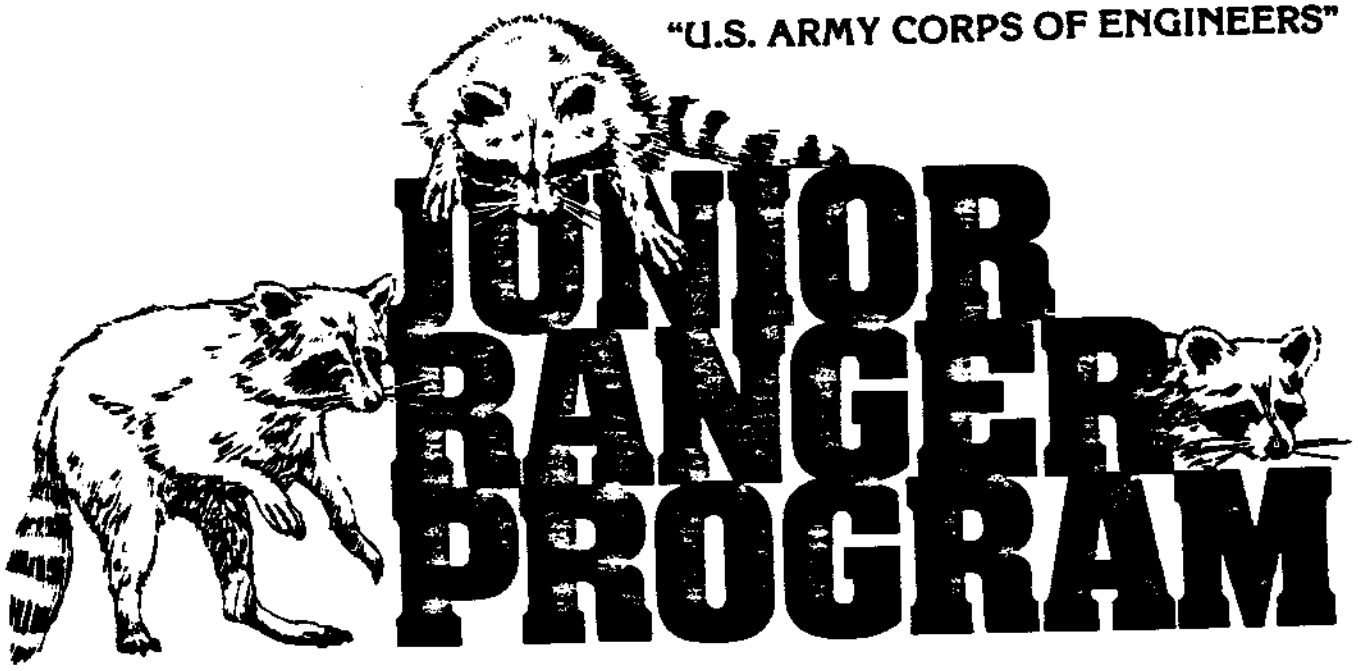
Data Required by the Privacy Act of 1974

1. **Authority:** N.A.
2. **Principal purpose for this information:** Provides personal information, i.e., name, age and mailing address for use in obtaining a Junior Ranger Certificate.
3. **Routine uses of this information:** Used by the U.S. Army Corps of Engineers to evaluate qualifications for the Junior Ranger Award, and to mail awards and other information about the Junior Ranger program. No other use of this personal data will be made.
4. **Mandatory or Voluntary Disclosure and Effect of Individual not Providing Information:** Disclosure of this information is voluntary. However, failure to disclose the requested personal information may prevent processing the application for Junior Ranger, and receipt by the applicant of mailing concerning the program.

What is a Junior Ranger?

A Junior Ranger is a young person, ages 6-12, who pledges to help protect our forests, parks, lakes and wildlife; and to assist park rangers in serving the public. The objective of the Junior Ranger Program is to develop in these young people an awareness and appreciation of the environment. It solicits their assistance in helping rangers and resource managers provide outdoor recreation opportunities while properly managing our natural and cultural resources. The program is designed to help develop in these young people an environmental ethic.

The Junior Ranger Program is sponsored by the U.S. Department of the Army, Corps of Engineers.



For more information, contact the

United States Army
Corps of Engineers
Nashville District

printed—December 1979

Junior Ranger Requirements

Any young person, aged 6-12, may join the Junior Rangers by completing certain requirements at any participating Corps of Engineers lake. Upon completion of the required activities, the candidate will be awarded a colorful, embroidered patch and a certificate worthy of framing. He or she will be entered on the rolls of the Junior Rangers.

The requirements are divided into five units of study. Each unit and the concepts which the candidate will be exposed to are as follows:

- **The Corps of Engineers Ranger**—"The Corps Ranger protects and manages the natural and cultural resources of the lakes, and looks after the well being of lake visitors."

- **Environmental Protection**—"We all must do our part to improve the quality of the environment and conserve our energy resources."

- **Wildlife Management**—"All wildlife is essential to the web of life, and provides us with many economic and social benefits. Wildlife should be protected and properly managed."

- **Forest Management**—"Forests, if properly managed, can provide us with multiple benefits, including recreation, wildlife habitat, wood products, watershed protection, and aesthetics."

- **Water Resources**—"Corps of Engineers lakes and other waters are not only used for transportation and water supply, but also for recreation. We should not pollute our waters. We must constantly practice water safety when we swim and boat in these lakes."

Each candidate will be given an application and scorecard to keep up with his or her progress. The activities for each unit may consist of attending a talk by a ranger, viewing a film or slide program, or developing a conservation essay or poster. Tree planting, litter cleanup, and environmental games may be other activities. All activities will be conducted by a Corps of Engineers Ranger, either at a participating lake or at your school or meeting place.

Contact the Ranger or Resource Manager at your nearby lake for details on how your students or organization members can participate in the Junior Ranger Program.

APPENDIX F

SAMPLE JUNIOR RANGER PROGRAM

A. The Corps Ranger

1. Explain the mission of the US Corps of Engineers.

2. Explain operation of the lake and its history.

3. Tour the Resource Manager's Office and Visitor Center.

4. Show the film "A Whole Lot Proud." Discussion.

5. Discuss the ranger's role in resources management.

6. Show ranger uniform, ranger vehicle, use of radio, and emergency equipment.

7. Discussion of people management problems at lake (safety, rowdyism, vandalism, law enforcement).

B. Environmental Protection

1. Show film "The Lorax." Discussion.

2. Show "Vandals Wild." Discussion.

3. Do two of the following:

(a) Clean up section of lakeshore.

(b) Test water sample from lake.

(c) Make an anti-pollution poster for school.

(d) Make a useful object from "garbage" to demonstrate recycling.

(e) Participate in web-of-life game.

4. List 10 ways of conserving energy. Discussion.

5. List five examples of pollution near your home or school. Discussion.

C. Wildlife Management

1. Show slides of fish and wildlife management practices on the lake.

2. Discussion - Corps versus state role in fish and wildlife management.

3. Show film "Realm of the Wild."

4. Discussion of hunting and fishing laws and gun safety.

5. Do two of the following:

(a) Attend snake program.

(b) Put up wood duck box or bird house.

(c) Plant a tree or shrub beneficial to wildlife.

(d) Make list of wildlife in the lake area.

(e) Participate in a hunting, fishing or wildlife observation activitiy with ranger or parent.

6. Show film "Our Endangered Wildlife." Discussion.

D. Forest Management

1. Show film "More Than Trees." Discussion.

2. Show film "I'm No Fool with Fire." Discussion of wildfires and prescribed fires.

3. List the various uses of forests. Discussion .

4. Do two of the following:

(a) Participate in a guided walk.

(b) Complete a self-guided nature trail.

(c) Plant an area with tree seedlings.

(d) Participate in a scavenger hunt.

(e) Remove nails and wires from trees in a campground.

(f) Assist park attendant at campground.

5. Discussion of Corps campground and day-use area management program.

E. Water Resources

1. Discuss the various uses of water resources projects (navigation, flood control, water supply, recreation, etc.).

2. Demonstrate one of the following skills (stress safety):

(a) Campcraft.

(b) Swimming.

(c) Canoeing.

(d) Fishing.

(e) Water Rescue.

(f) Artificial Respiration.

3. Show film "I'm No Fool in Water." Discussion.

4. Make a list of common objects that can be used to save a drowning person. Discuss drawing.

5. Discuss food chain in a lake and how pollution can affect it.

6. Discussion - Lakeshore Management and Water-Use Zoning.

EXHIBIT V

PRE-VISIT, SITE-VISIT, AND POST-VISIT ACTIVITIES

USING THE SUBJECTS "WETLANDS"

and

"TEACHER'S GUIDE TO BONNEVILLE DAM"

The following **ACTIVITY 2: WETLANDS, VALUES, FUNCTIONS, AND CONSERVATION** was reproduced by permission of the Fish and Wildlife Service. Taken from a booklet titled "In Celebration of America's Wildlife: Teacher's Guide to Learning."

ACTIVITY 2: Wetlands, Values, Functions, and Conservation

VIDEO: The following lesson plan pertains to the video's discussion about wetlands, wood ducks, and beavers.

CONCEPT: Species of wildlife are only as healthy or abundant as the habitat in which they live. Wetlands are critical habitats because they are few in number and vital to wildlife. Any habitat and its associated plants and animals may be in danger if humans do not recognize its importance and work to protect it.

OBJECTIVES:

1. Students will learn the values and functions of wetlands in problem-solving sessions by debating citizens' concerns about their loss.
2. Students will improve communication skills by role-playing and sharing ideas in small groups.
3. Students will improve analysis and decision-making skills by reaching conclusions based on knowledge of wetland values and functions and on the needs and desires of various citizens.
4. Students will gain an appreciation for the difficulty of making decisions about public land-use by weighing and evaluating multiple and opposed viewpoints.

SKILLS: Community awareness, conflict-resolution, decision-making, role-playing

BACKGROUND: "Wetlands" is a general term used to describe land areas that are saturated with, or covered by, water part or all of the year. Bogs, swamps, saltwater and freshwater marshes, and intertidal pools are examples of the many types of wetlands. Aquatic environments such as oceans and rivers, where the water is too deep for sunlight to penetrate to the bottom and for plants to grow, are not wetlands. However, wetlands are commonly found near these deep-water habitats. For example, intertidal pools are found along the coast and freshwater marshes are often located beside lakes.

In the past, the term "wetland" was almost synonymous with "wasteland" -- areas that were thought to be productive only after they were drained and replaced. While this negative image prevailed, millions of wetland acres were drained, dredged, and filled, primarily for agricultural and residential purposes. In fact, only one-half of the original wetlands of the continental United States still exist. Only a small part of the loss of wetlands in rural areas has been offset by the construction of farm ponds and irrigation ditches.

Attitudes toward wetlands are changing as people learn more about their unique values and functions. They are of particular significance to wildlife.

Wetlands are considered to be among the most productive areas in the world because they provide breeding grounds for a remarkable variety of insects, fish, amphibians, reptiles, small mammals, and birds. Waterfowl, like the wood duck, use wetlands for rearing their broods and as feeding and resting areas along their migration routes. In addition, the complex food webs of oceans and lakes are enhanced by wetlands. Wetlands provide living and dead matter for deep-water animals to feed upon and breeding grounds for many species of fish and shellfish.

Wetlands are valuable to people, too. They can reduce the impacts of floods by holding vast quantities of water that would otherwise inundate adjacent lands. They also act as buffers that prevent the erosion of shorelines and riverbanks. Wetland plants can purify water by taking up and using pollutants (particularly nitrogen and phosphorus) that run off agricultural lands and paved areas. Some wetlands provide commercial items, such as fish, shellfish, cranberries, and peat moss. Wetlands also provide countless opportunities for recreational, educational, and aesthetical benefits for those who hunt, fish, canoe, watch birds, study nature, hike, or otherwise enjoy the outdoors.

Although some wetlands are still being destroyed for development and agriculture, the trend of dredging and filling wetlands is slowing. In 1977, President Jimmy Carter issued an Executive Order (#11990) which states that all Federal agencies must do their utmost to avoid disturbance or destruction of wetlands on Federal lands. Since 1985, farm legislation has denied certain financial subsidies to farmers who destroy wetlands.

PROCEDURES:

Ask students to recall (or review) the segment of the video about wetlands and wood ducks. Engage them in a discussion about wetlands by asking questions such as:

1. What are wetlands and how do they differ from lakes and oceans?
2. Have any of you visited a wetland? Can you describe it? Was it a marsh, bog, swamp, etc...? What kinds of plants and animals were living there?
3. In what ways are wetlands valuable to wildlife, to humans?
4. Does anyone know why wetlands are considered "critical" habitats?
5. Are there any wetlands near your home or around town that are being drained and filled with soil? If so, for what purpose? What will happen to the plants and wildlife that live there?

Of course, the students will not know all the answers. Teachers will need to add information (from the teacher's BACKGROUND section) that the students do not cover

in their discussion. If time allows, have students research these and other relevant questions in the library. Outline the values and functions of wetlands on the board.

Next, divide the class into groups, with two of the groups having no more than six members each. Explain to the class that the city planners of their town are considering draining and filling a marsh on city-owned property for the purpose of creating a public park. The marsh is located in a part of town which has no public recreational center.

The city planners have asked the public to comment on their plans at a public meeting. The students will participate in a mock town meeting in which everyone plays a role. One of the groups of six members will represent the proponents of the park plan and the other will represent the opponents. A third group will represent the city planners who are in a position to go ahead with, cancel, or modify their plans. Complex state and Federal regulations concerning land development and impacts on fish and wildlife would come into play in an actual decision. You may want to consult with a representative of an involved agency.

Pass out copies of the citizen interest cards (pages 15-18). Each student from the proponent group should be given a card as should each member of the opponent group. Allow time for the students to become familiar with their roles. During this time, encourage the group of city planners to anticipate questions and concerns that the citizens may have, to think of how they will respond to them, and to consider alternatives (if any) to developing the marsh into a park. In addition, encourage the students in each group to assist each other in formulating and strengthening the critical points of their presentations.

Conduct the mock town meeting in an orderly fashion, alternating between speakers for and against the park development. Expect some clapping, booing, and hissing. Each student should be given 2-3 minutes to present his or her case. Encourage the students to energetically portray the role they have been assigned. Allow for orderly interchange, new questions, and assertions. After all views have been presented, give the group of city planners 10-15 minutes to elect a spokesperson and make their land-use decision.

Proponents and opponents can gather in respective groups to discuss how their arguments were received and how their position could have been strengthened. Provide the city planners with large format paper and bold markers to write out their decision and the main reasons for making that decision. Have the spokesperson make a short presentation to the class using the format paper as a visual aid.

Once the decision has been presented to the class, encourage discussion by asking questions such as:

1. Was everyone pleased by the decision? Is pleasing everyone a realistic goal in a situation like this?

2. What criteria were used to make the decision? Was the decision reasonable?

3. What alternatives were considered and why were they rejected?
4. What are the consequences of the decision to wildlife? to humans? to the environment?
5. Is the representation at a hearing likely to be balanced? All of the people who would benefit from a new park live close by, but many who benefit from the wetland's flood protection and waterfowl live far away downstream or down the flyway.

OPTIONS AND FOLLOW UP:

Depending on the available time, include:

1. A general discussion about the difficulties of land-use decisions and a reiteration of wetland values and functions.
2. Presentation of additional information about the marsh/park situation. For example, inform the class that this marsh is one of the few stop-over locations for migrating waterfowl in the area.
3. Substitute development for a commercial building or factory in place of the public park for an additional activity. Does the stereotype of building development for big business versus park alter the final role-playing decision?
4. Find a similar wildlife/environmental problem in the area. Identify the groups and attitudes. Can consensus be reached?

CITIZEN INTEREST CARDS

(Copy pages and cut on lines)

OPPONENTS OF PARK DEVELOPMENT

ADJACENT LANDOWNER

- Prefers the marsh to the park, despite the summertime mosquitos
- Likes the peace and quiet of the marsh; associates parties and loud music with the park
- Likes the quiet street; anticipates increased traffic flow to the park

---

DEPARTMENT OF WATER QUALITY REPRESENTATIVE

- Supports preservation of the marsh
- Explains that marshes function as filters that remove pollutants and sediments, making the water that flows out of the marsh cleaner than the water flowing in

---

LOCAL UNIVERSITY PROFESSOR OF ECOLOGY

- Understands that parks and open spaces are necessary, but is adamant that the park should be built elsewhere
- Has studied a rare species of fish that lives in the marsh. He says that the marsh population is the only one living in the state, although the species is found outside the state

---

FLOOD CONTROL SPECIALIST 1

- Supports preservation of the marsh
- Explains that marshes serve as natural sand bags, retaining water and reducing flood damage
- Concerned that flood waters from the adjacent river will do much more damage to neighborhood streets, sidewalks, and private property in the absence of the marsh

---

PROPONENTS OF PARK DEVELOPMENT

DEPARTMENT OF PUBLIC HEALTH REPRESENTATIVE

- Supports park development
- Concerned that an occasional high population of mosquitoes may facilitate an epidemic of encephalitis, canine heart worm, or other disease

LOCAL CITIZEN

- Supports park development
- Believes that the relaxation and recreation needs of the neighborhood residents have been neglected for too long

NEIGHBORHOOD ASSOCIATION CHAIRPERSON

- Supports park development
- Believes that the park will raise property (and resale) values of the neighborhood houses
- Plans to run for city council next year and hopes to use the successful development of the park to her advantage

LOCAL PARENT/LITTLE LEAGUE SOCCER COACH

- Supports park development
- Says that the park would provide a home field for the neighborhood little league team
- Says that the park would provide a safe alternative to other parks by reducing the distance that neighborhood children have to travel to play or practice sports

LOCAL HIGH SCHOOL SCIENCE TEACHER

- Supports preservation of the marsh
- Says that she and other local science teachers frequently use the marsh as an outdoor classroom

A CONSERVATION SOCIETY PRESIDENT

- Supports preservation of the marsh
- Says that the society is willing to build a boardwalk through the marsh to increase its recreational value
- Says that the society members will lead weekly bird walks through the marsh during the migration seasons

CHAMBER OF COMMERCE MEMBER

- Supports park development
- Owns an acre of commercially zoned land across from the park and has already begun to plan a plaza with an ice cream shop and restaurant

COMMUNITY CULTURAL ARTS CHAIRPERSON

- Supports park development and especially the idea of an outdoor amphitheater
- Says that an outdoor theater and concert arena would improve the community's visibility and increase revenues

FLOOD CONTROL SPECIALIST 2

- Does not favor the marsh
- Prefers that a deep, straight, concrete or grass-lined canal be built to hold and speed water away from the city
- Considers it possible for a park to use land adjacent to the canal if adequate safety precautions are taken when flooding is imminent

Teacher's Guide to Bonneville Dam

*GPO 792-691-93

Teacher's Guide To Bonneville Dam

Packet #2

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1988 Summer Visitor Center Staff

Table Of Contents

Goals of The Teacher's Guide to Bonneville Dam

The goals of the **Teacher's Guide to Bonneville Dam** are:

To aid project personnel in accomplishing management objectives such as increasing public understanding of management issues including controversial issues, reducing vandalism, reducing the number of drownings, or other management problems in order to offset dwindling manpower resources.

To enhance general understanding of the role of the U.S. Army Corps of Engineers in development and administration of water resource projects.

To enhance general understanding of the purpose and operation of the project, its man-made, natural and cultural features.

To develop general appreciation for proper use of project resources in an effort to reduce overall project operation and maintenance costs.

Objectives of The Teacher's Guide to Bonneville Dam

1. To build an understanding of the Corps of Engineers and its missions, specifically navigation, hydropower, resource management and recreation.
2. To explain the mechanics of, and to explore the need for power production, fish passage facilities, navigation locks, resource management and recreation in this region.
3. To increase participants' understanding of the cultural and natural history of Bonneville Dam and its environs through education and interpretation.
4. To explore the individuals' relationship and responsibility to the production and use of energy and other resources.
5. To increase participants' understanding of their interrelationships with the Corps of Engineers and to encourage their future interest in the agency.
6. To reduce monetary and environmental losses by instilling in participants an ethic of stewardship and safety at U.S. Army Corps of Engineers areas.
7. To enrich participants experiences at Corps areas by making them aware of recreational facilities and opportunities at Bonneville Dam and the surrounding region.
8. To provide an educational experience for participants which is relevant to their lives and which supplements the curricula of regional educational institutions.

Introduction To The Teacher's Guide

This is a collection of information and suggested learning activities for teachers and students. It is intended to enrich the experience of their visit to Bonneville Dam and increase their understanding of the Corps of Engineers.

How This Guide Is Organized

This packet is the second in a series of two packets. It is designed for grades 5, 6, 7 and 8. The first packet is targeted at grades 1, 2, 3 and 4.

To serve as a supplement to school curricula, the TEACHER'S GUIDE has been divided according to subject. Topics covered include: The Corps of Engineers, Hydropower, Navigation and the Navigation Lock, Natural Resources Management (including anadromous fish), and Recreation.

Each subject area provides factual information on that topic and at least two suggested activities to be implemented before, during, and after your visit. With this information, you will be able to design a tour to meet your individual needs.

Although many of the included activities are designed for specific locations and segments of your visit to Bonneville Dam, with slight modifications they can also be used in a classroom setting. Additionally, this TEACHER'S GUIDE can be used as an information resource.

Planning A Visit To Bonneville Dam

In planning your visit to Bonneville Lock & Dam Project, there are several decisions you must make. You must determine: if you want assistance from the Visitor Center staff; what subjects are of most interest; and what facilities at the project you will visit.

Visiting Bonneville Dam on your own for the first time can be somewhat overwhelming! There is much to be seen and shown to your students. For that reason, trained Corps of Engineers staff members are available to take you on special group tours. Once you have an idea of how to get around the Project, then you can create and lead your class tours.

If you plan to utilize the staff to lead your tour, we recommend that you contact the visitor center at least one month in advance to make a reservation for your group. If you plan to visit during the spring, which is one of the busiest school group seasons, you should call several months ahead to reserve the specific day you had in mind.

The reservation number is (503) 374–8820.

When you call, please have the following information ready:

1._____The date of your visit to Bonneville Dam. (have several possible dates to avoid a second call if there is a scheduling conflict.)

2._____Which visitor facilities you would like to visit. (see pages 9 and 10 in this guide for a listing)

3._____How much time you will have to spend at the dam and how long your tour should last.

4._____The name of your school or organization.

5._____The name of the person in charge of the group and their phone number.

6._____The number of people in your group, their age or grade level, and how many supervising adults will accompany them.

7._____Which subject you'd like to emphasize during your visit. This includes details of any specific activities you would like or special assistance you will require.

Facilities At Bonneville Dam

Once you have determined the date of your visit and whether or not you will personally lead the tour, it is important for you to consider which area of the project you would like to visit. This will depend mostly on the subjects you wish to emphasize during your visit. Although visitor center staff can assist you with this decision, this brief listing of facilities at Bonneville Dam and what subjects are most suited to each area may help.

Facilities Accessible From I–84 Exit 40 (Oregon)

The Bradford Island Visitor Center.

This five–story visitor center contains exhibits about the natural and cultural history of the region; a multi–image theater where several films and slide shows are available; fish ladders; underwater fish ladder viewing; a small picnic area; snack machines and restrooms. A series of ramps, walkways, and elevators make this site accessible to People with Impairments.

Navigation Lock.

View the lock from the south side of the lock. Signs will direct you to the appropriate parking area. From this vantage point, you can watch a tug and barge going through the lock. Although there is no guarantee when a boat may go through, there are lockages every day. There is access for people with impairments.

First Powerhouse.

Reached from the Bradford Island Visitor Center, the First Powerhouse Viewing Gallery provides a view of the generators. Informative exhibits are also found in this visitor area. If you are specifically interested in the production of electricity, you should consider visiting the Second Powerhouse on the Washington shore, where visitor areas have been created to allow you to safely walk on top of a running generator. A series of ramps, walkways, and elevators make this site accessible to wheelchairs.

Spillway.

Although automobiles and pedestrians are not permitted on the spillway, it may be viewed from the Bradford Island Visitor Center.

Bonneville Fish Hatchery.

Operated by the Oregon Department of Fish and Wildlife, the hatchery highlights include the Hatchery Operations Building where salmon are processed; rearing ponds for young salmon; and ponds where live sturgeon and trout may be viewed and fed. For hatchery tours call (503) 374–8393.

Picnic Facilities And Restrooms.

Both may be found at the Bradford Island Visitor Center and the Bonneville Fish Hatchery.

Sternwheeler Cruises.

During summer months, the Sternwheeler, operated by the Port of Cascade Locks may be boarded at the dock near the Bradford Island Visitor Center parking lot. For schedules and reservations contact the Port of Cascade Locks, Oregon (503) 374–8619.

Public Telephone.

Telephones are located at the Bradford Island Visitor Center and the Bonneville Fish Hatchery.

Facilities Accessible From Highway 14 (Washington)

Second Powerhouse Interpretive Complex.

Facilities include:

The Visitor Orientation Building, contains a visitor information desk, exhibits about the project, restrooms and snack area. The second powerhouse is reached from this building. This entire complex is accessible to wheelchairs.

The Second Powerhouse, provides a setting for students to learn about and experience how hydropower is generated. Highlights include a display gallery and access to the actual generators. A self-guiding loop route to public areas is marked throughout the powerhouse.

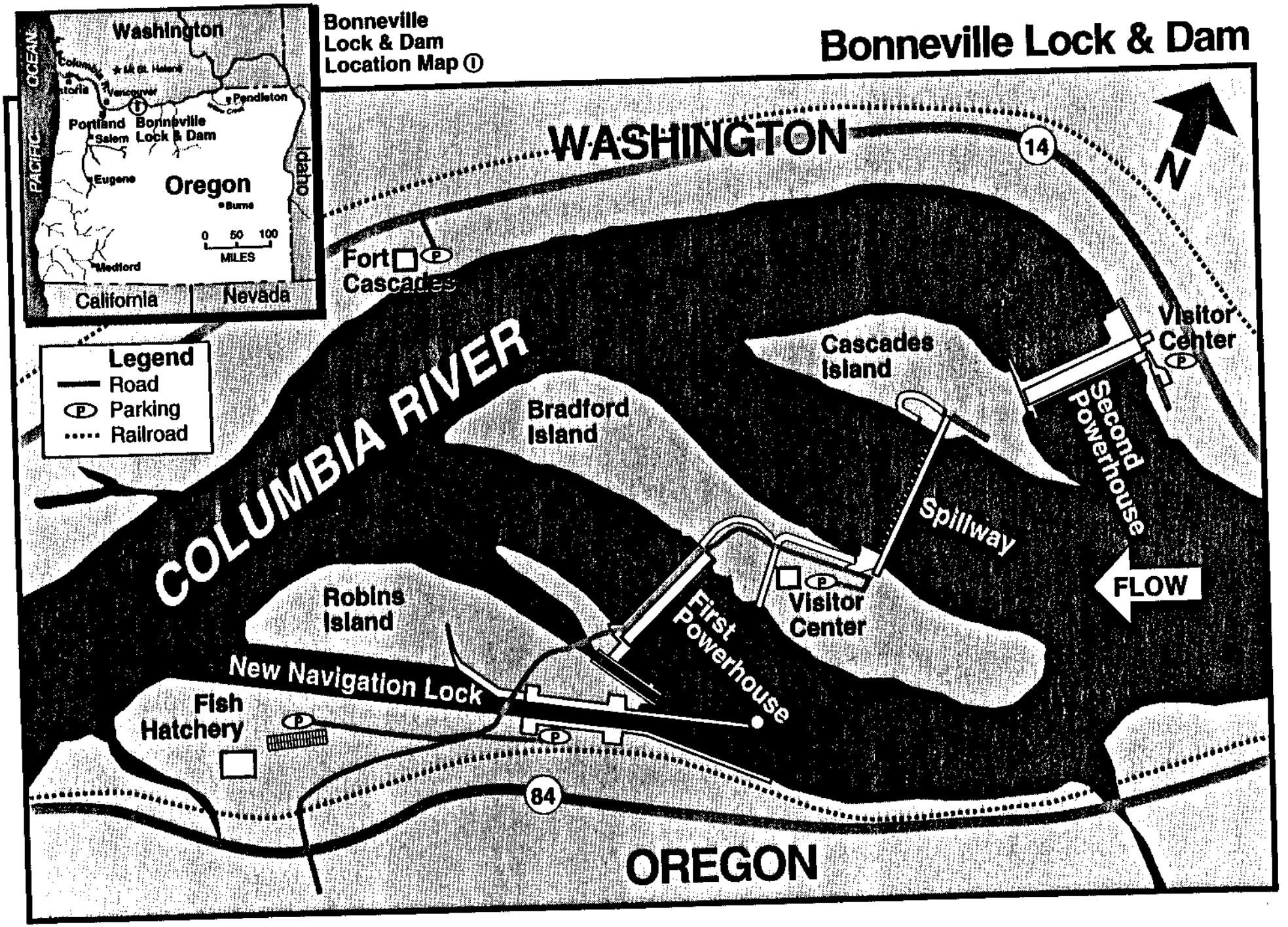
The Fish Viewing Building, provides an opportunity to see into the fish ladders used by adult salmon in their upstream migration. Exhibits about fish and the history of Columbia River salmon fishing provide students with information about the life cycle of the migrating salmon.

Picnic Facilities And Restrooms.

Please ask at the information desk about picnic areas currently open. Restrooms are located inside the Visitor Orientation Building, the Powerhouse, and the Fish Viewing Building.

Public Telephone.

A pay telephone is located outside between the Visitor Orientation Building and the Fish Viewing Building.


Bonneville Lock & Dam
Bonneville Lock & Dam Location Map ①
Washington
Oregon
Portland
Salem
Eugene
Medford
Bonneville Lock & Dam
Pendleton
Idaho
PACIFIC OCEAN
California
Nevada
0 50 100
MILES
WASHINGTON
14
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Fort Cascades
Visitor Center
Cascades Island
Second Powerhouse
Bradford Island
COLUMBIA RIVER
Spillway
FLOW
Legend
Road
Parking
Railroad
Robins Island
First Powerhouse
Visitor Center
New Navigation Lock
Fish Hatchery
84
OREGON

Teachers Checklist

The following checklist may help to organize your trip to Bonneville Dam.

1._____Have you contacted the visitor center staff to make a reservation? (see "Planning a Visit," page 1)

2._____Have you reviewed all of the pre-trip activities with your group?

3._____Have you decided which on-site activities you will use at the dam? Will you conduct these or have you arranged for assistance from the visitor center staff?

4._____Have you looked at the map and the list of facilities and planned your route and schedule?

5._____Have you arranged for at least one adult for every 10 children?

6._____Have you read the sections about "What to do on the way to Bonneville Dam"? (This information is found in the "During Your Visit" section of each subject.)

We Need Your Comments And Suggestions

YOU ARE THE EXPERTS..... As you read the following, please keep in mind that your feedback on our product is important. Consider if the information is too complex; the activities understandable; the directions clear; etc.. Comments are welcome! Please complete and return the following comment sheet.

General Adaptable Activities

Below is a list of general activities which can be adapted to fit almost any subject area. You can use these activities in addition to the two site-specific activities provided within each subject area.

Watch An Audio-visual Program.

The Bradford Island Visitor Center has a large selection of films and slide shows which relate to the many responsibilities of the Corps of Engineers at Bonneville Lock and Dam. Programs range from 5 to 25 minutes in length. Although our film library may vary from year to year, we normally have programs covering a variety of topics, including: the Pacific Salmon, the building of Bonneville Lock and Dam, the Lewis and Clark journey, etc. "The Lorax" (a Doctor Suess presentation) can be a fun way for the children to learn about conservation. If you are interested in seeing a movie during your visit, it is best to make arrangements with the Visitor Center Staff so they can help you select the most appropriate show for the subject you will emphasize and the age of the group.

Make A Collage.

This activity is excellent before or after your visit. If used before your visit, have your students bring in pictures related to the subject; have an art project and discussion while cutting out objects in the classroom; or have your students draw pictures themselves to be put together in a class collage. Students can also create individual collages representing their personal ideas about the topic. If used after your visit, have your students create a collage from the brochures that they collect during their visit. Visitor center staff can give a packet of brochures to each student if this is arranged prior to your visit.

Create Your Own Mobiles.

Like the collage activity, making class or group mobiles can be done before or after your visit. Again, materials necessary for the activity may be cut from magazines, drawn by the students, or collected during their visit to the dam. If your class has access to a camera, photographs can hang from the mobile to recap some of the memorable moments of the visit.

Create A Sight And Sound Experience.

This post-trip activity will stimulate your student's senses and reinforce what they saw at the dam by having them associate the sights and sound of their tour of Bonneville Dam.

To create this activity, you will need a 35 mm camera (use slide film) and a portable tape recorder. Then, photograph and record a variety of sights and sound during your tour of the Dam. If a camera is not available this activity can be set up using pictures you cut out from magazines and have mounted on cardboard. Either way, have fun dazzling your student's senses and imaginations. See below for ideas.

What To Include In Your Show:

Use slides and sounds of people, birds and animals, boats, water, generators, construction equipment, or anything else relevant to your theme or subject area. For example, you might use slides and sounds that include:

- Types of recreational activities enjoyed by people at Bonneville Dam. (anglers, water-ski boats, sails moving in wind, etc.)
- A Corps ranger helping an injured person. (sounds of the truck, siren, walking ranger with jingling keys, or ranger helping find out how the person is feeling, etc.)
- A ranger giving someone information. (sounds of the visitor center, telephones ringing, etc.)
- A ranger going through the daily routine of managing the natural resource of the area. (caring for the Canada geese or the plants, etc.)
- Someone on a boat telling a friend why they should put on a life jacket.

- Someone picking up litter. (sound could be garbage blowing in the wind...i.e. a tin can, etc.)
- The sounds of the generators spinning and the water rushing by.
- Water moving over the fish ladders (include people making comments about the fish they are seeing)
- An angler catching a fish. (use sounds of fish thrashing around)

Once you have put together your show, gather the group in a place where slides may be shown. Explain that they are about to hear a sound from their visit and that you would like them to raise their hands once they have identified the sound. After you have discussed what the students think the sound is, show the slide of the object.

Hints For Your Film/Sound Debut:

It is a good idea to leave the screen blank while playing the sounds. Those who are trying to guess the origin of the sound will not be distracted or confused by the image of the past sound producer.

Variations:

To make the exercise a thinking and sound-making exercise for your students, you might also think about having them make the sounds they think of for the pictures that you show.

"News Clipping" Show And Tell.

Have older students keep track of the current events around the Columbia Gorge by having them cut newspaper clippings about topics associated with area.

Have A Spelling Bee.

Before your visit, you can help familiarize your students with important vocabulary words by having a "Spelling Bee." You can easily use those words underlined in each of the subject areas IMPORTANT CONCEPTS section. We have found that students who are familiar with these words seem to better understand what they are experiencing during their visit.

The U.S. Army Corps Of Engineers An Introduction

The purpose of this subject area is to introduce your students to the U.S. Army Corps of Engineers and their role as a water management agency.

The first section of activities is included to introduce your students to the roles of the Corps. Activities that take advantage of the visitor facilities at Bonneville Dam are next and finally, activities for after your visit have been included to reinforce the concepts learned about the Corps.

History Quickie

President Jefferson, recognizing the need for information about the area west of the Mississippi, dispatched his private secretary, Captain Meriwether Lewis, along with Captain William Clark, on their now-famous expedition.

It was the U.S. Army Corps of Engineers which received the overall assignment for surveying and exploring the West. The officers in charge of the operations were educated at West Point, which was founded by the Corps and was the only engineering school in the country at the time. They were commissioned as topographical engineers. Their mission was to obtain the scientific data necessary for opening the frontier to settlement. They became scientist-explorers, skilled in both the natural sciences and in the practical techniques of surveying and mapping.

Important Concepts

The activities in this section will help the student understand the following concepts. Important vocabulary words are in bold print.

The **Army Corps of Engineers** built and operates Bonneville Lock and Dam. An engineer is someone who uses mathematical and scientific principles in the design, construction and operation of structures, equipment and systems.

The Corps is a part of the U.S. **government.** The leader of this and other parts of the U.S. government is the President of the United States.

Some people who work for the Corps are in the Army; some are not. Most of the people who work for the Corps are civilians. Bonneville Dam is operated by civilian employees of the Corps.

The Army Corps of Engineers was founded in 1775 when Colonel Richard Gridley was appointed by George Washington as Chief Engineer of the Continental Army during the Revolutionary War.

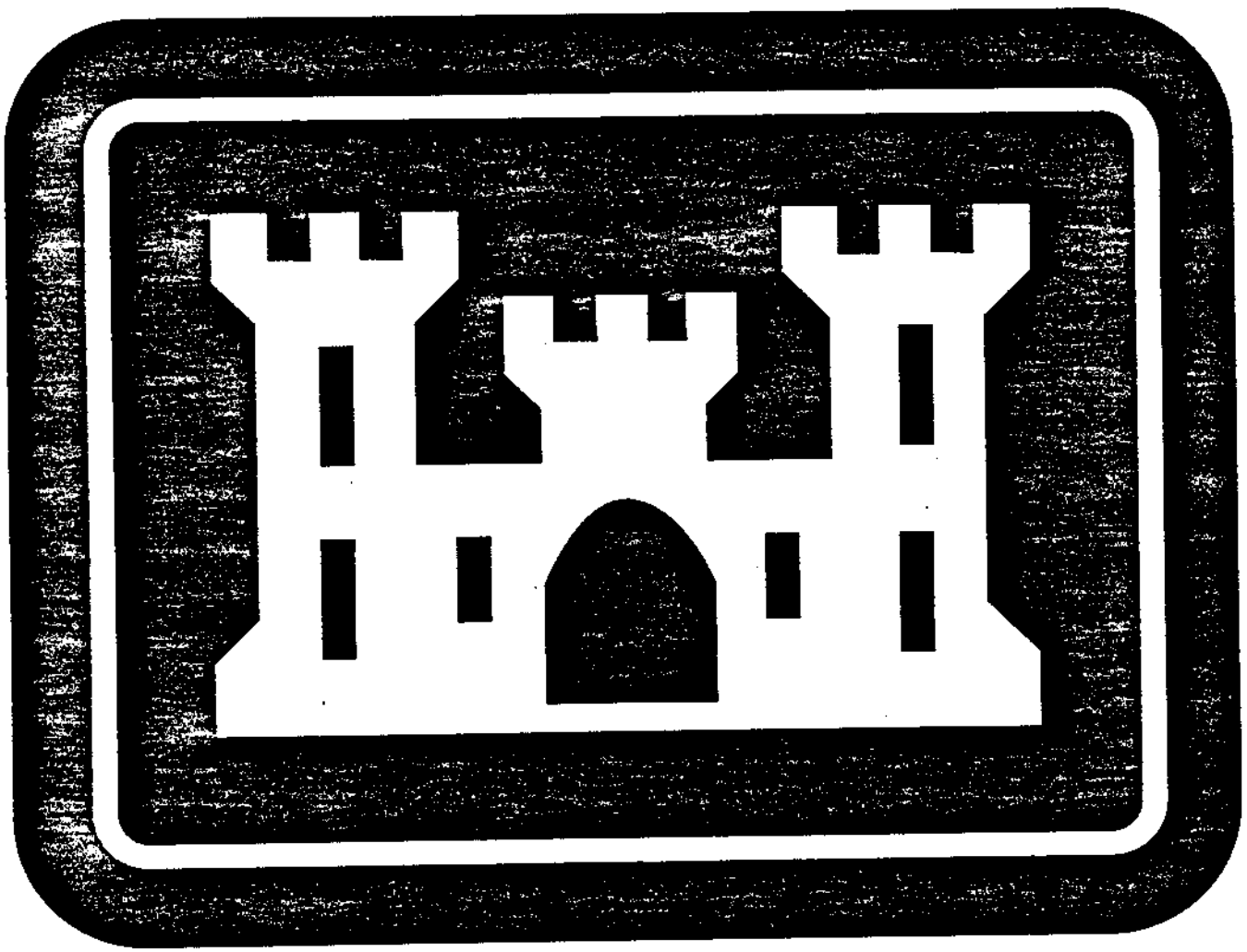
After the war the new nation needed roads and bridges and forts. As the nation's only organized engineers, the Corps was assigned the challenge and began its dual role in defense and civil works.

Later the Corps was given the task of making the Mississippi River **navigable,** and thus the role as a **water management agency.**

As a water management agency, the Corps has several missions. They are: **producing hydropower,** improving **navigation** by providing locks, maintaining inland **waterways** and harbors, managing **natural resources** in such a way as to provide **environmental protection** and enhancement, managing **recreation sites,** providing **flood control,** supplying water for **irrigation,** industry and **municipalities.**

At Bonneville Dam we do four of those things: produce hydropower, provide navigation locks, manage for recreation, and manage the natural resources.

The castle you see on the next page is the Corps insignia. It symbolizes fortification, a traditional activity of military engineers.



US Army Corps of Engineers
Portland District

The U.S. Army Corps Of Engineers Before Your Visit

The two following activities, the Water Cycle Game and Mission: Decode, are intended to introduce your students to the Corps role as a water resource management agency.

Activities

The Water Cycle Game

The Water Cycle Game, complete with directions and rules, is attached. After you have played the basic Water Cycle Game a few times, you can add these advanced rules to make the game more challenging!

Pre-game Discussion:

To help your students make the connection between the water cycle and the missions of the Corps at Bonneville Dam, talk briefly about these before the game. Four missions have been mentioned on the board: irrigation, navigation, resource management and hydropower generation.

Beginning and Taking Turns:

Begin and proceed with the game in the same manner as before.

Special Instructions:

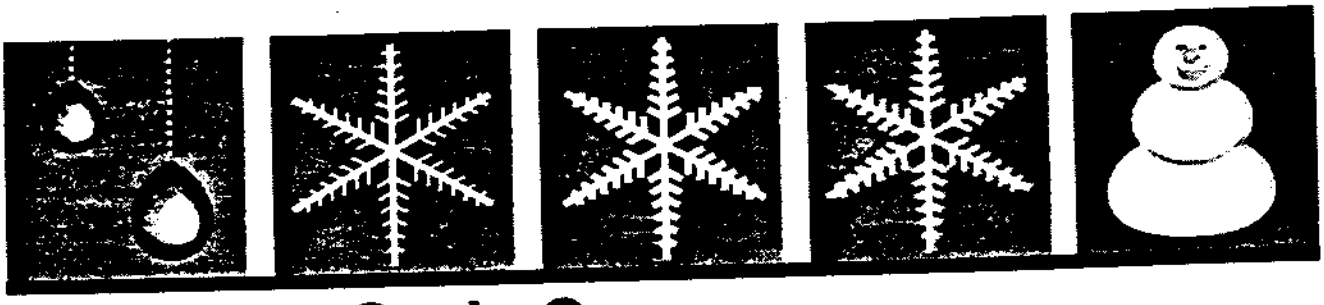
For this advanced version, each student will need paper and pencil. When a player lands on a blue drop, follow the instructions and answer the question listed below for that drop number. If the correct answer is given, one point is scored. Keep track of the score!

Ending:

Go through the Water Cycle Game twice. After all markers have evaporated to the clouds the second time, add up each persons points. The person with the most points is the winner.

Mission: Decode

This activity will give students a chance to discover and understand the responsibilities or missions of the U.S. Army Corps of Engineers.



The Water Cycle Game

Drop Number	Question
2a	How is a glacier different from a patch of snow?
2b	What is precipitation?
5a	In which season are floods most likely to happen?
5b	In which season are droughts most likely?
7a	What does "transpiration" mean?
7b	What is a water table?
11a	What does "irrigate" mean?
11b	Why do farmers irrigate?
19a	What is "navigation"?
19b	What are some of the products that are taken through the navigation locks on barges?
28a	What is wrong with dumping garbage into the river?
28b	How can littering hurt wildlife?
33a	What is the minimum number of people you should have in a boat when pulling a water skier?
33b	What is a "P.F.D."?
39a	Why do salmon swim up the river?
39b	What are fish ladders for?
41a	What is another word for "making" electricity.
41b	Which federal agencies build and operate dams to make electricity?
46a	What is an "estuary"?
46b	What is a tide?
50a	What does "evaporate" mean?
50b	Name three types of precipitation.

The Water Cycle Game

Answers:

Drop Number	Question
2a	How is a glacier different from a patch of snow? **A patch of snow will melt in the spring. A glacier has many layers of snow that have turned into ice and will remain through the seasons.**
2b	What is precipitation? **Precipitation is water falling from the sky in some solid or liquid form.**
5a	In which season are floods most likely to happen? **spring, in the Columbia River Basin**
5b	In which season are droughts most likely? **summer, in the Columbia River Basin**
7a	What does "transpiration" mean? **A tree has specialized cells called stomata in its leaves and stems which are like the pores in our skin. Water evaporates from these stomata when they are open. This is called transpiration.**
7b	What is a water table? **The water table is the level of the water in the ground, or how far you have to dig to have a well.**
11a	What does "irrigate" mean? **Irrigate means to "supply water for use on farm land, by artificial means".**
11b	Why do farmers irrigate? **Many times farmers irrigate when their farms are in a warm, sunny location with fertile soil, but not enough rain to support the crops they are trying to grow. Therefore, they bring the water to the plants.**
19a	What is "navigation"? **Navigation is like driving somewhere in your car using a road map, except that it is done in a boat on the water.**
19b	What are some of the products that are taken through the navigation locks on barges? **Grains, wood chips, lumber, petroleum products, salmon and trout fingerlings**
28a	What is wrong with dumping garbage into the river? **A river is home for many types of life. Pollution can kill native plants, animals and fish.**
28b	How can littering hurt wildlife? **Litter usually isn't biodegradable (does not decompose on its own). Even slowly degrading litter can ensnare or be toxic to animals.**

33a What is the minimum number of people you should have in a boat when pulling a water skier? **At least two; one to operate the boat and one to watch the skier.**

33b What is a "P.F.D."? **Personal flotation device...a life jacket.**

39a Why do salmon swim up the river? **Salmon swim upstream to return to the place they were reared, where they will lay their eggs and die.**

39b What are fish ladders for? **Fish ladders make it possible for returning adult salmon to pass over the dam by providing "steps".**

41a What is another word for "making" electricity. **"Generating" electricity.**

41b Which federal agencies build and operate dams to make electricity? **Army Corps of Engineers and Bureau of Reclamation.**

46a What is an "estuary"? **An estuary is a partially enclosed coastal area where ocean water flows into the mouth of a river during high tide. It is a zone of both salt and fresh water. Where these two environments meet, a unique and biologically productive area is formed.**

46b What is a tide? **A tide is the periodic rise and fall of water in the ocean caused by the gravitational pull of the moon.**

50a What does "evaporate" mean? **Evaporate means to change water from a liquid state to a gaseous state. In nature, this process is powered by the energy of the sun.**

50b Name three types of precipitation. **Rain, sleet, hail, snow.**

Mission: Decode

Your mission is to decode the messages below.

Here is how the code works. The numbers 1 through 26 stand for the letters A through Z respectively. Therefore 1 = A, 2 = B, 3 = C, etc. Fill in the correct letters and decode the message.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

1. The Army Corps of Engineers is a part of the 21.14.9.20.5.4 19.20.1.20.5.19 government. The 12.5.1.4.5.18 of the Corps and of our 3.15.21.14.20.18.25 is the 16.18.5.19.9.4.5.14.20 of the United States.

2. The Army Corps of Engineers and other parts of the United States government are 6.21.14.4.5.4 by the 20.1.24.5.19 that people pay.

3. Three of the main jobs of the Corps of Engineers are building and maintaining 4.1.13.19, navigation 12.15.3.11.19, and 10.5.20.20.9.5.19.

4. 6.12.15.15.4 control and 9.18.18.9.7.1.20.9.15.14 are two reasons that some dams are built.

5. The Army Corps of Engineers 4.5.19.9.7.14.5.4 and operates 2.15.14.14.5.22.9.12.12.5 Lock and Dam.

6. The main missions of the Corps of Engineers at Bonneville Dam are generating hydroelectric power, maintaining and improving 14.1.22.9.7.1.20.9.15.14, managing natural 18.5.19.15.21.18.3.5.19, and providing recreational opportunities.

7. The Bonneville project includes navigation 12.15.3.11.19, a 19.16.9.12.12.23.1.25 dam, two powerhouses, two visitor centers, and a fish 8.1.20.3.8.5.18.25.

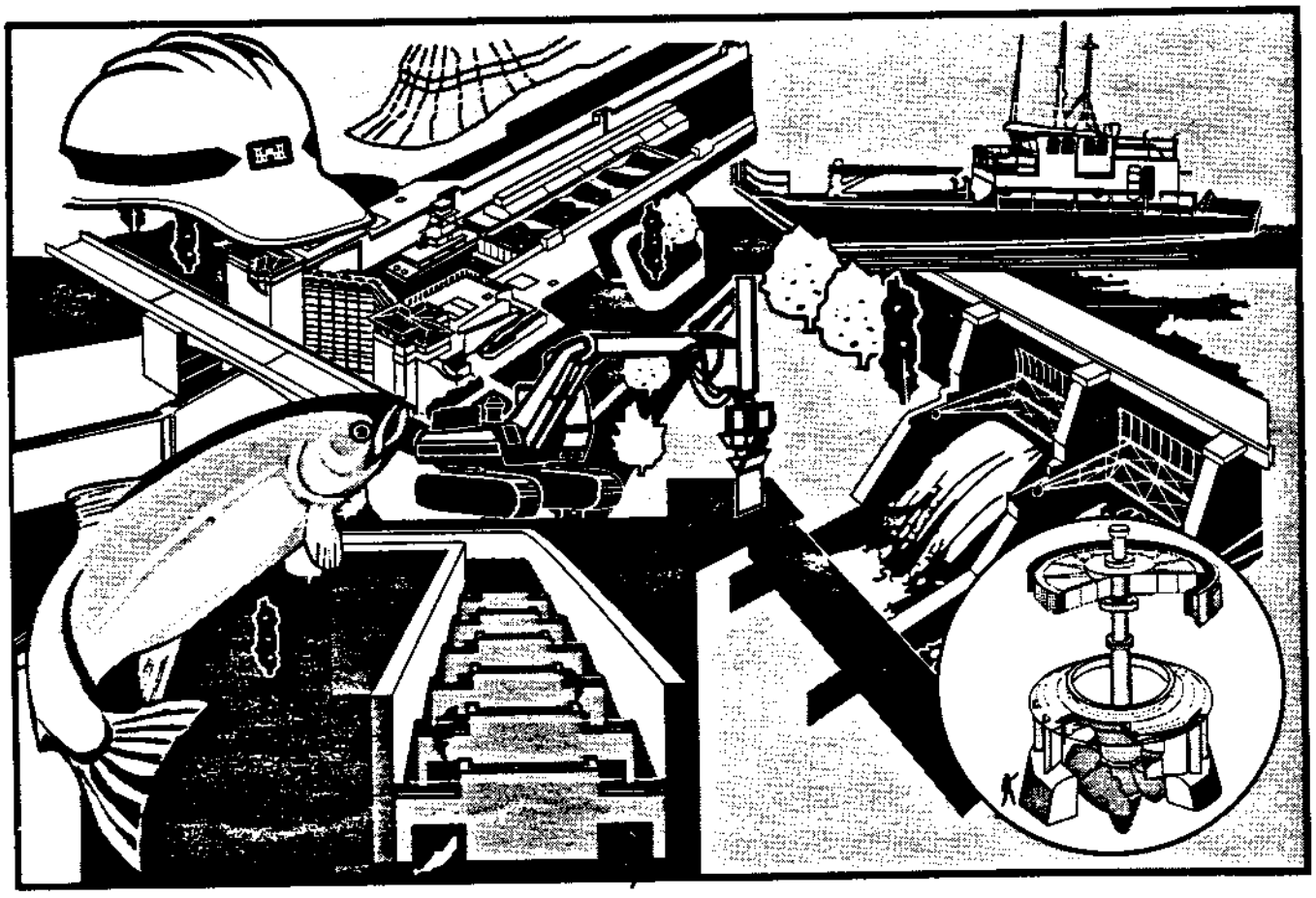
8. Hydroelectric power allows all of us to use 5.12.5.3.20.18.9.3.9.20.25 generated by the energy of 18.9.22.5.18 water. This electricity comes to us in a 16.15.12.12.21.20.9.15.14–free, renewable form.

9. Navigation locks at dams make it possible for large 2.1.18.7.5.19 pushed by 20.21.7 boats to transport oil, 7.18.1.9.14, and wood products up and down the river.

10. Lots of people use Corps of Engineer areas for recreation. Many people 6,9,19,8, swim, 3,1,13,16, and boat in these areas.

11. The Corps of Engineers is also responsible for 13,1,14,1,7,9,14,7 natural resources. One important 18,5,19,15,21,18,3,5 in the Columbia River is fish.

12. At Bonneville Dam, fish 12,1,4,4,5,18,19 were built to help fish swim upstream to their 19,16,1,23,14,9,14,7 grounds.



19,5,3,18,3,20 SECRET

Hold up to mirror to decode

Mission: Decode

Answers:

1. **United States, leader, country, President**
2. **funded, taxes**
3. **dams, locks, jetties**
4. **flood, irrigation**
5. **designed, Bonneville**
6. **navigation, resources**
7. **locks, spillway, hatchery**
8. **electricity, river, pollution**
9. **barges, tug, grain**
10. **fish, camp**
11. **managing, resource**
12. **ladders, spawning**

The U.S. Army Corps Of Engineers During Your Visit

Your students can learn more about the Corps of Engineers during their visit to Bonneville Dam. Here are some suggestions to accomplish that goal.

What To Do On Your Way To The Project:

While traveling to the project, your students could look for barges in the river. Most of these barges have to pass through the locks at Bonneville Dam. Also, look for transmission lines. These lines may be carrying the electricity produced at Bonneville Dam to the homes of your students.

Ask The Visitor Center Employees:

The staff at the Bradford Island Visitor Center and at the Visitor Orientation Building will be happy to tell your group about the roles of the Corps of Engineers.

Bradford Island Visitor Center:

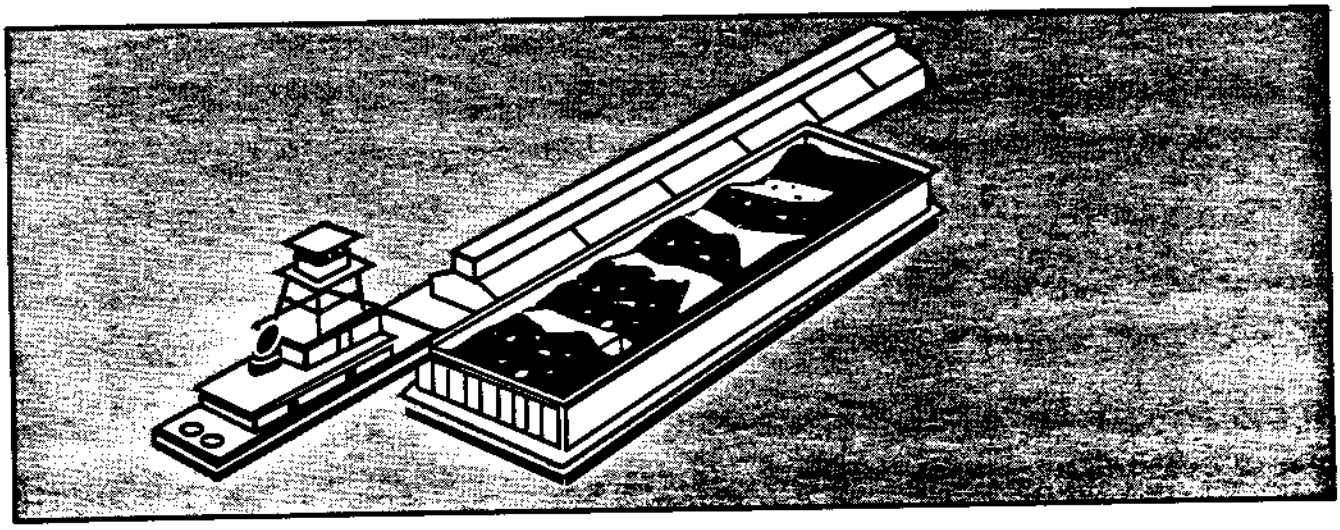
Exhibits on the fourth floor of the Bradford Island Visitor Center will introduce your students to the role of the Corps of Engineers. There are also displays on the fourth floor about the jobs done by Army Corps employees.

Films:

Films about the Corps of Engineers are shown in the theaters at the Bradford Island Visitor Center and the second powerhouse. Please request a film showing when you reserve time for your visit.

Visitor Orientation Building:

On the main floor of the Visitor Orientation Building (on the Washington shore), you will find talking figures that explain the duties and tasks of five employees at Bonneville Dam.



The U.S. Army Corps Of Engineers
After Your Visit

The following activities are to be completed after your visit to Bonneville Dam. They are intended to reinforce vocabulary and concepts learned before and during the visit.

Activities

Name The Missions Of The Corps:

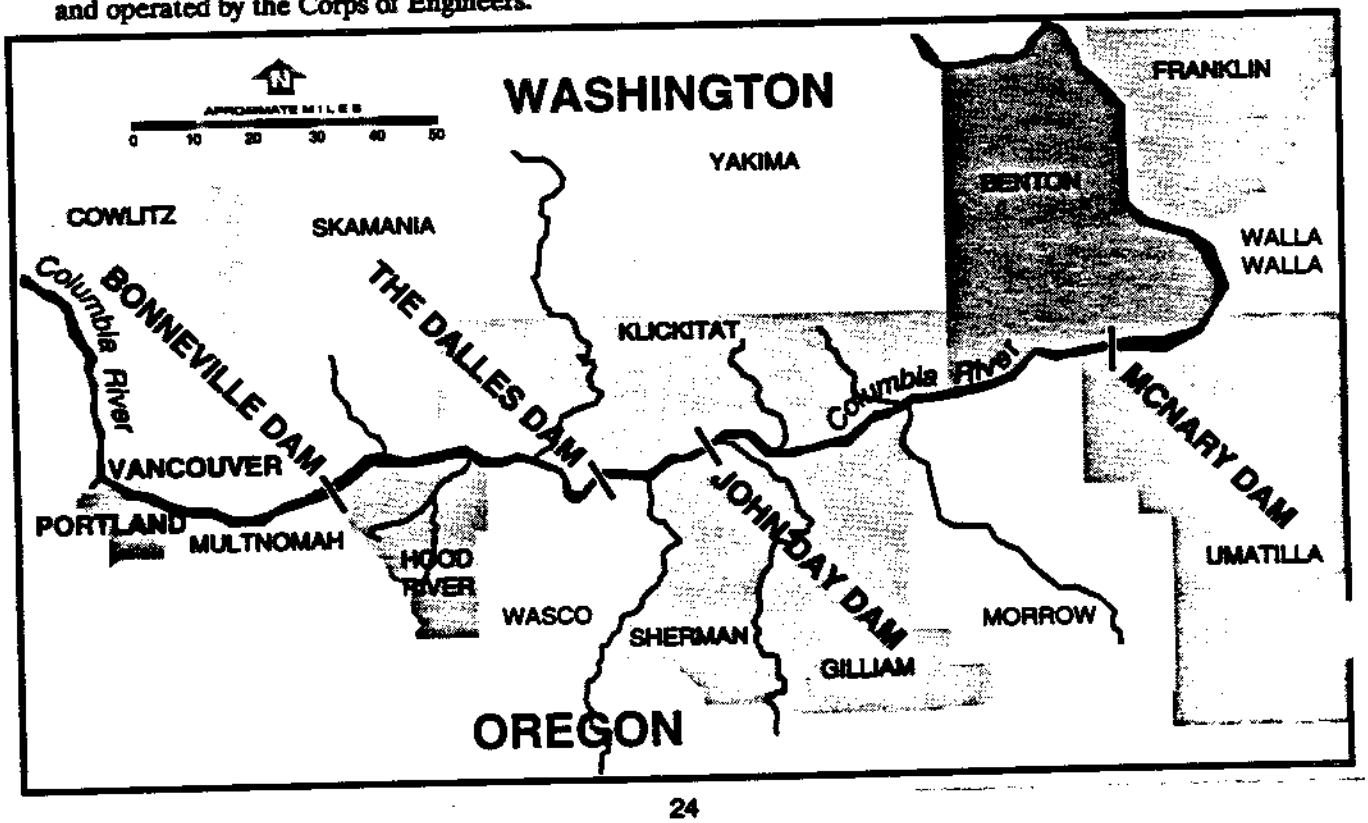
This activity will reinforce understanding of the missions or responsibilities of the U.S. Army Corps of Engineers.

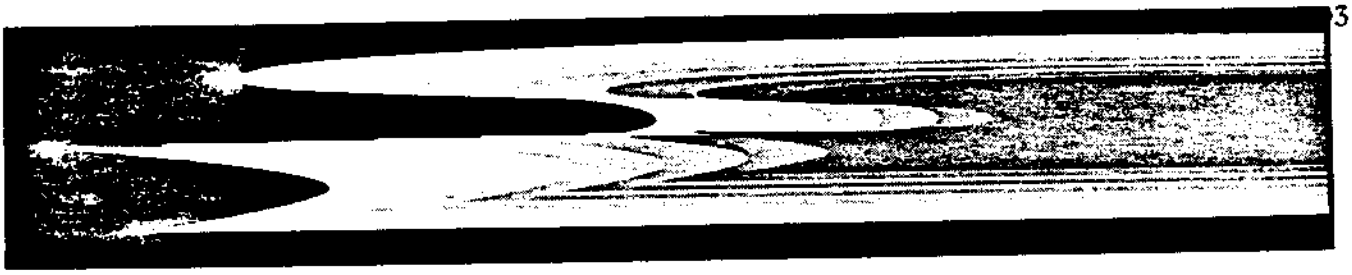
Who Am I?:

Many people work at Bonneville dam keeping it operating smoothly, helping visitors and working to maintain the natural resources of the area. This activity gives students an opportunity to match the employee with the tasks they accomplish.

Visit Other Projects:

The Dalles, John Day and McNary dams are the next three dams on the Columbia River. They also are designed and operated by the Corps of Engineers.





Name The Missions Of The Corps!

Match the words in the list of missions of the Corps with their definitions.

The list of missions:

1. Navigation

2. Hydropower

3. Flood Control

4. Irrigation Water Storage

5. Resource Management

6. Water Based Recreation Management

Definitions to match them to:

A. ___A clean renewable source of electricity

B. ___Improving and maintaining waterways for the passage of ships

C. ___Managing resources for the safe enjoyment of waterways

D. ___Using, protecting and enhancing environmental resources

E. ___Controlling the river's flow to prevent flooding

F. ___Impounding water used to grow crops in dry areas

Name The Missions Of The Corps!

Answers:

A. **2** – Hydropower

B. **1** – Navigation

C. **6** – Water Based Recreation Management

D. **5** – Resource Management

E. **3** – Flood Control

F. **4** – Irrigation Water Storage

Who Am I?

Match the job title with the description of the tasks performed on the job.

Job Title:	Task Performed:	
Carpenter	1_____	I paint everything from turbines to cabinets.
Fish Biologist	2_____	I start and stop generators and control the flow of water through the dam.
Fish Counter	3_____	I insure the safety of the public. I am trained in rescue and first aid.
Garage Mechanic	4_____	I evaluate fish passage and perform research to improve salmon runs.
Welder	5_____	I operate the lock which lifts boats past the dam.
Lock Operator	6_____	I keep the generators in good condition.
Electrician/Mechanic	7_____	I provide information and services for the public.
Painter	8_____	I type, file and work as a receptionist
Park Guide	9_____	I count fish as they pass by the dam. Many agencies use my information to help fish.
Park Ranger	10_____	I perform a wide variety of tasks all involving wood.
Powerhouse operator	11_____	I keep all vehicles in good condition.
Project Manager	12_____	I join metal to metal with my torch. I make and repair anything metal.
Secretary	13_____	I supervise the entire project and all employees.

Who Am I?

Answers:

1. painter
2. powerhouse operator
3. park ranger
4. fish biologist
5. lock operator
6. electrician/mechanic
7. park guide
8. secretary
9. fish counter
10. carpenter
11. garage mechanic
12. welder
13. project manager

Hydropower
An Introduction

The purpose of this subject area is to familiarize students with the production of hydropower at Bonneville Dam.

The first section includes activities which may be used to introduce hydropower concepts in the classroom. Next are self- guided tours of each powerhouse and an on-site activity. Finally, activities are included for after your visit to help reinforce what has been learned about the production of hydropower.

History Quickie

Bonneville Dam was built in the 1930's during the Great Depression. At this time Franklin D. Roosevelt campaigned for president of the U.S. promising, if elected, he would bring work to the Northwest by constructing the next federal hydropower dam on the Columbia River. Bonneville Dam was funded by the P.W.A. or Public Works Administration. The dam was originally designed with only two generators and room for an additional four. People called it the "Dam of Doubt" and "Roosevelt's White Elephant" because they doubted whether they were going to be able to use all that electricity. Some felt that the building of the dam was an extravagant waste of federal funds.

Because the electricity made at Bonneville Dam was much less expensive than that from other sources, the demand for electricity grew rapidly. Even before the completion of the dam in 1938, four more generators were installed.

The addition of another four generators was started in 1939 and finished in 1943. This brought the number of generators in the first powerhouse to ten.

Important Concepts

The activities in this section will help the students understand the following concepts. Important vocabulary words are in bold print.

Energy is the work a physical system is capable of doing in changing from one state to another. Electricity is a form of energy.

An **electrical current** is the flow of electrons. An **electron** is a very small particle that orbits around the nucleus of an atom. Electrons have a negative electrical charge.

There are **atoms** that are good electrical **conductors**, such as copper or aluminum atoms. They have electrons that can be easily pulled from their orbit. Passing a magnet over a copper wire will excite the electrons in the copper atoms.

When there is work for electricity to do, we call it a "load." A load or the completion of an **electrical circuit**, will cause the excited electrons to jump from their original atom to the next atom, leaving a space to be filled by another excited electron. This exchange of electrons becomes a flow, this flow is an electrical current.

Generators produce electricity. A generator is a machine that spins magnets past coils of copper wire.

A commercial turbine generator unit, such as those at Bonneville Dam, consists of two main parts; the generator and the turbine. The generator (upper half of the unit) consists of two main parts, the **rotor** and the **stator**. The rotor is an electromagnet, the stator is coils of copper wire.

The generator is connected to the turbine (lower half of the unit) by a shaft. When a potential energy source is harnessed (i.e. wind, sun, water, or steam power) it can be forced to turn the turbine which is a giant propeller.

Water falls through a hydropower dam (due to the force of gravity) and turns the turbine, the turbine turns the shaft, the shaft spins the rotor which spins inside the stator and produces electricity.

Hydropower means water power, and is the term used for electricity generated at a dam.

The part of the dam that houses the generators is called the **powerhouse**. There are two powerhouses at Bonneville Dam, one on the Oregon side and one on the Washington side of the Columbia River. The part of the dam in the middle is called the spillway.

The **spillway** is the part of the dam that holds back, or releases, extra water. The spillways along the river help control the water so that it can be used for many uses. Water is spilled at Bonneville Dam mainly in the springtime for two reasons: 1) to help fingerlings that are on their way to the ocean; and 2) to pass river flow in excess of the hydroelectric capacity of the two powerhouses.

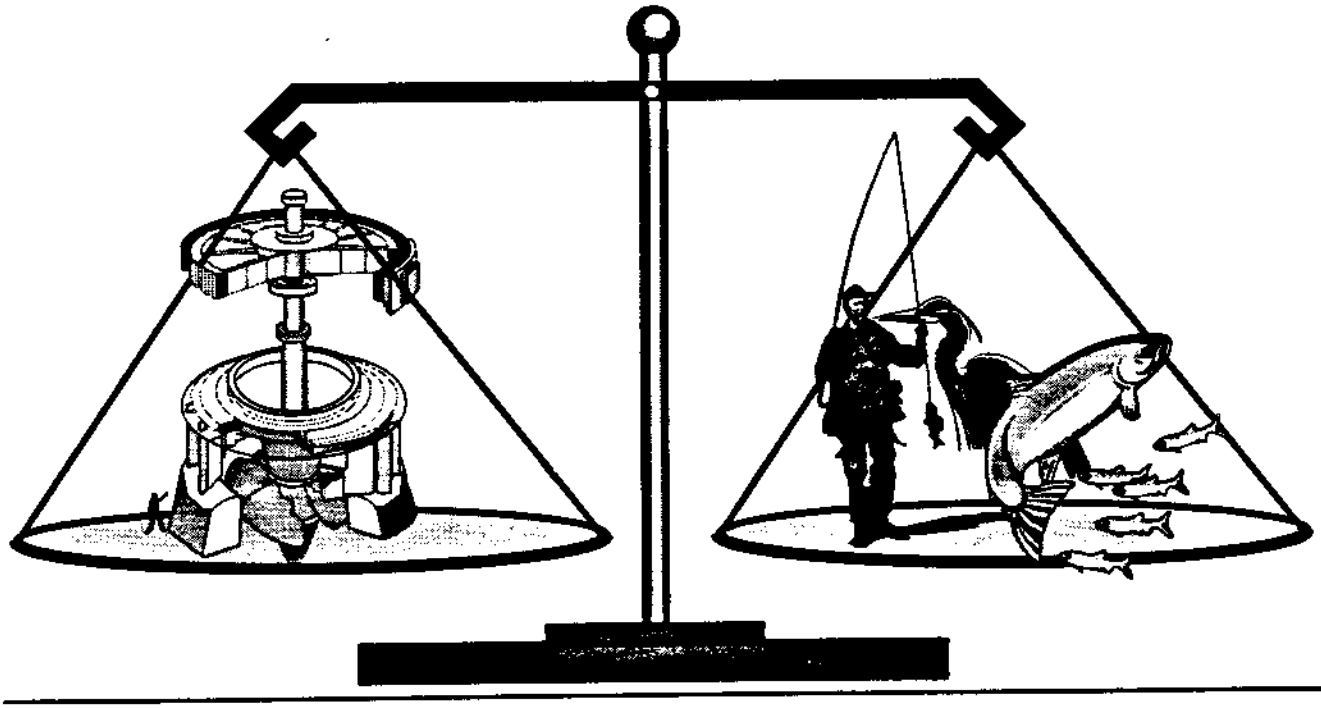
We measure electricity in watts. 1 volt x 1 ampere = 1 watt. Amperage is the amount of electricity that is present, voltage is the velocity or force of the electricity. A **kilowatt** is a thousand watts. A **megawatt** is a million watts. Bonneville Dam can produce over a million kilowatts of continuous output when operating at full capacity. That is one thousand **megawatts.**

The electricity is delivered to your house through transmission lines. The excited electrons in the copper coils of the generator cause the electrons in the connecting wires to also be excited and flow.

Transmission lines are built by the **Bonneville Power Administration.** The B.P.A. is a **government marketing agency** formed to market and distribute the electricity produced at federal dams and nuclear plants. They sell electricity to local utilities, the **local utilities** sell the electricity to users.

Conservation means using a **resource**, such as a river, to fulfill people's needs while not over-using it and depleting or destroying it. At Bonneville Dam we use the Columbia River to make electricity, facilitate transportation and to provide recreational opportunities. We also manage the natural resources in order to protect the river's fish and wildlife.

When we attempt to practice conservation we become involved in tradeoffs. A **trade-off** means balancing one **benefit** against another. When we build a hydropower dam we trade a wild and **natural** river for electricity, easier river navigation etc.. Some of the advantages associated with hydropower are: it is **renewable** due to the **water cycle**; it doesn't **pollute** the air or water; it can create or enhance habitat for some fish and wildlife; and it provides relatively inexpensive power. Some of the disadvantages associated with hydropower are: the high monetary costs to build a hydropower dam; the lake behind the dam covers up lands that may have had farms, towns, wildlife, and fish spawning grounds on them; dams and the lakes they create are difficult for **anadromous fish** like salmon to get past; and the loss of wild river scenery and recreation.



Hydropower
Before Your Visit

The following activities about hydropower are designed to be used before you bring your students to Bonneville Dam.

Activities

Label The Powerhouse:

Students should be given a copy of the activity "LABEL THE POWERHOUSE." They may label the powerhouse by reading the descriptions of the various "parts" and by filling in the blank spaces which have been provided. Students may also color the different parts of the powerhouse.

What Is A Watt?

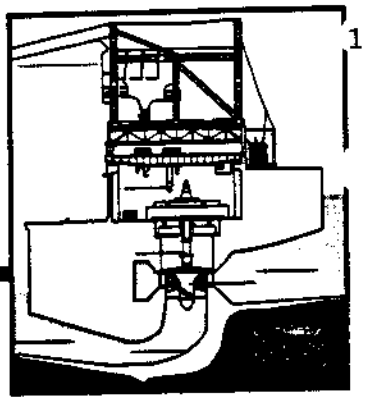
This sheet, to be completed by the student, will help students learn about watts. Utility companies use watts for billing users. They charge according to the number of watts used multiplied by the amount of time they have been used.

You And Your Electric Bill/Energy Eaters:

These activities will give students an idea about what appliances in the home use the most electricity and about how much these appliances cost to operate.

Energy Riddles:

These energy riddles are designed to help build a "hydropower" vocabulary. We suggest that you first have your students complete the activity,"LABEL THE POWERHOUSE," before you try the riddles.



Label The Powerhouse

Read the following definitions of the "parts" of a powerhouse. Then, label the powerhouse. There is one space on the diagram for each word.

Turbine A turbine is a large metal machine which is turned as the water passes through the powerhouse. It looks like a giant pinwheel or propeller.

Generator A generator is the part of the powerhouse which makes electricity. Part of the generator is attached to the turbine. So, when the turbine turns, so does a part of the generator. The generator has two parts, coils of wire and magnets.

Intake The opening in the dam that lets water through to create electricity.

Shaft The shaft connects the turbine to the generator so that when the turbine spins it also spins the rotor which is inside the generator.

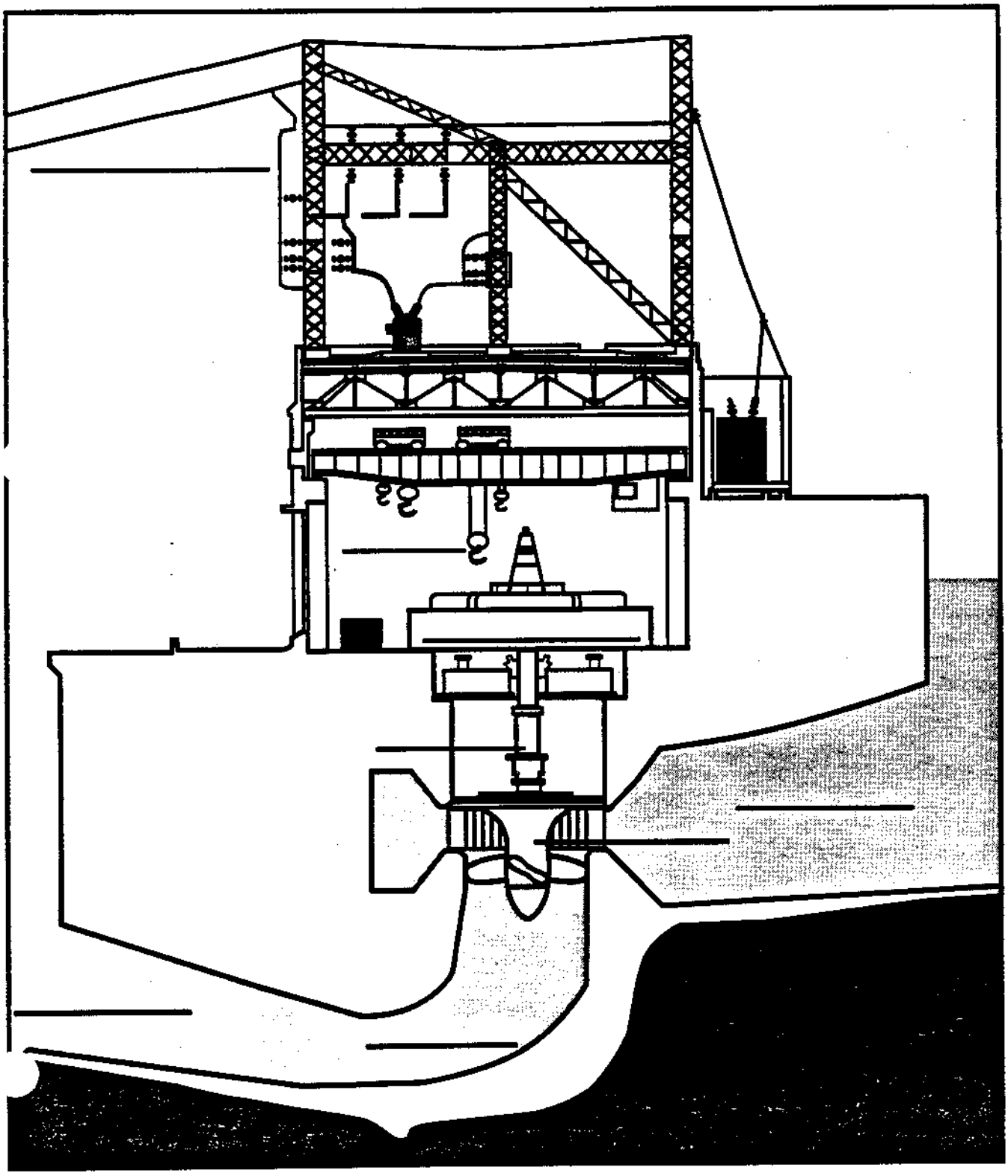
Exit The exit is where the water goes immediately after falling through the turbine.

Transmission Lines The transmission lines carry electricity from the powerhouse to your house.

Tailrace The tailrace is where the water comes out of the powerhouse. If you stand on the downriver side of the powerhouse you will see the water, or tailrace, churning and bubbling.

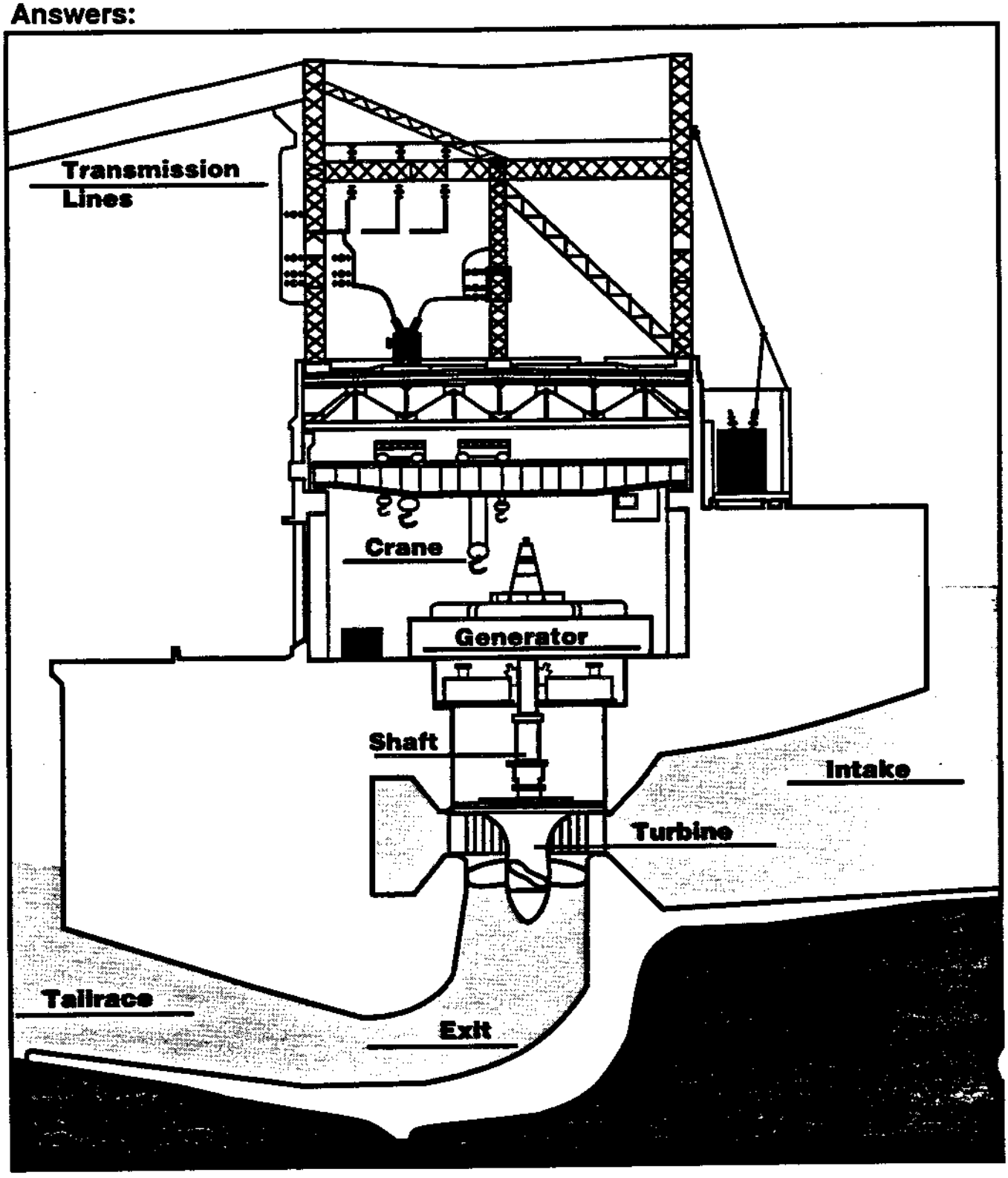
Crane The crane is used to lift parts of the generator straight up so that the generator can be fixed. It slides across the ceiling of the powerhouse on rails.

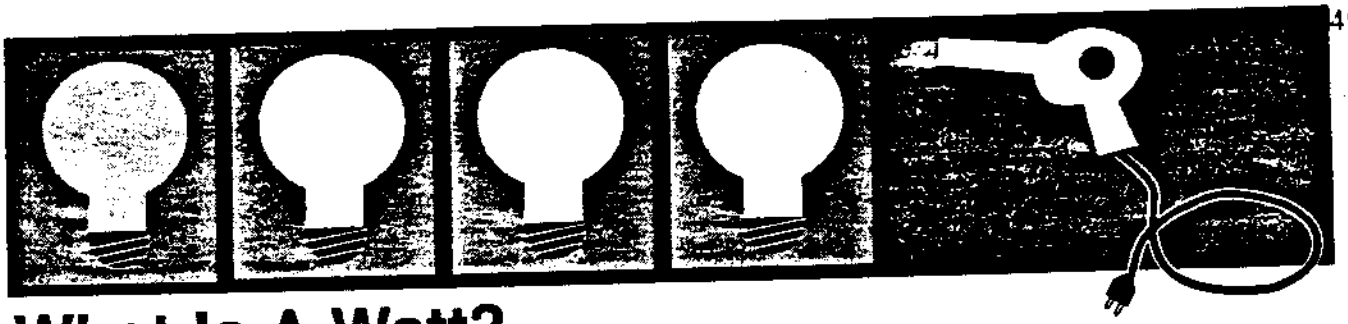
Label the Powerhouse:



Label the Powerhouse

Answers:





What Is A Watt?

A **Watt** is an amount of electrical power. For example a 60 **Watt** light bulb uses 60 **Watts** of electricity. Likewise, a 100 **Watt** light bulb uses 100 **Watts** of electricity.

When you go home tonight, ask your Mom and Dad to help you find out how many **Watts** are used by any of the following things in your home. The number of **Watts** that an appliance uses should be written on the appliance.

1. Any light bulb in your home _____WATTS
2. An electric toaster _____WATTS
3. A television _____WATTS
4. A plug-in radio _____WATTS
5. A hair dryer _____WATTS
6. An electric blanket _____WATTS
7. A refrigerator _____WATTS
8. _____(other) _____WATTS

Kilowatts: Bonneville Dam generates so much electricity that it is measured in thousands of Watts. Another name for 1,000 Watts is a **Kilowatt. Kilo** means 1,000. Bonneville Dam produces over **One Million Kilowatts**!

How many 100 watt light bulbs would it take to use one kilowatt of electricity?_____

How many 50 watt light bulbs could be lit by one kilowatt?_____

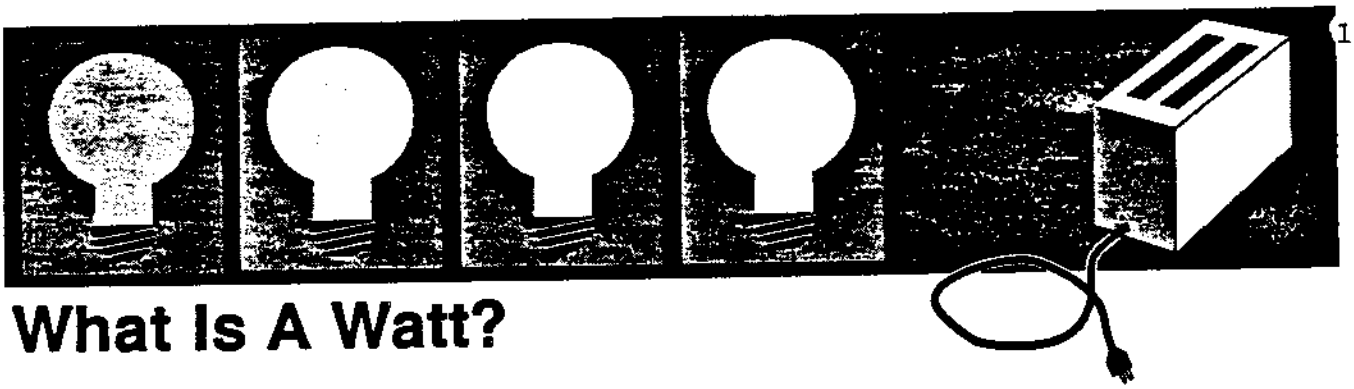
Kilowatt Hours: If you use 1 kilowatt for 1 hour you will use 1 kilowatt hour!

One kilowatt x 1 hour = 1 kilowatt hour.

When you use ten 100 watt light bulbs for one hour how many kilowatt hours would you use?_____

If you used a 6,000 watt air conditioner for 2 hours, how many kilowatt hours would you use?_____

_____



What Is A Watt?

Answers:

1.	Any light bulb in your home	100 WATTS
2.	An electric toaster	1,146 WATTS
3.	A television	145 WATTS
4.	A plug-in radio	71 WATTS
5.	A hair dryer	600 WATTS
6.	An electric blanket	630 WATTS
7.	A refrigerator	1,450 WATTS
8.	_____(other)	_____WATTS

Kilowatts: Bonneville Dam generates so much electricity that it is measured in thousands of Watts. Another name for 1,000 Watts is a **Kilowatt**. **Kilo** means 1,000. Bonneville Dam produces over **One Million Kilowatts**!

How many 100 watt light bulbs would it take to use one kilowatt of electricity? 10

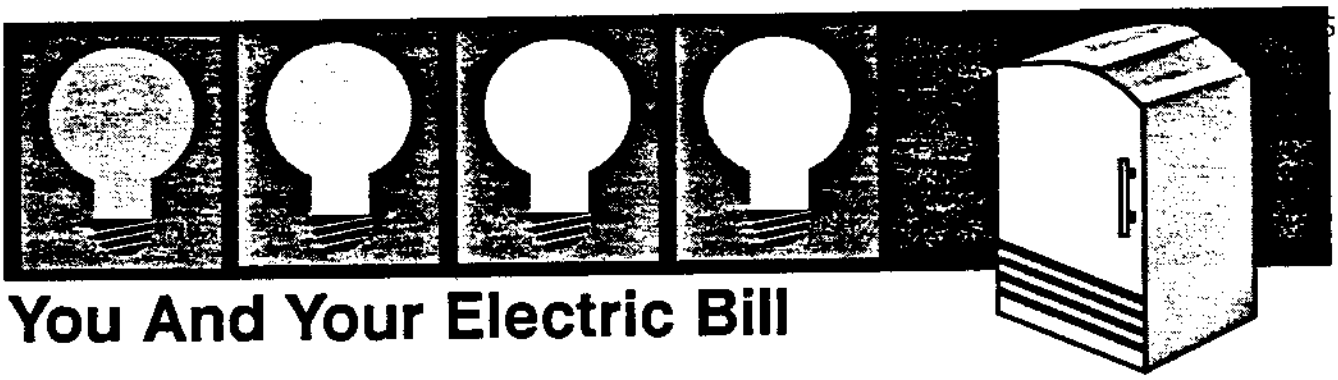
How many 50 watt light bulbs could be lit by one kilowatt? 20

Kilowatt Hours: If you use 1 kilowatt for 1 hour you will use 1 kilowatt hour!

One kilowatt x 1 hour = 1 kilowatt hour.

When you use ten 100 watt light bulbs for one hour how many kilowatt hours would you use? 1

If you used a 6,000 watt air conditioner for 2 hours, how many kilowatt hours would you use? 12



You And Your Electric Bill

Before you read this page, be sure you have read the page titled, **What Is A Watt**?

Look at the electric bill from your electric company. Who is your electric company? What do they charge for a kilowatt hour of electricity?

Let's suppose that it costs you 5 cents for 1 kilowatt hour. That means if you use 1000 watts (one kilowatt) for one hour you will use 5 cents worth of electricity!

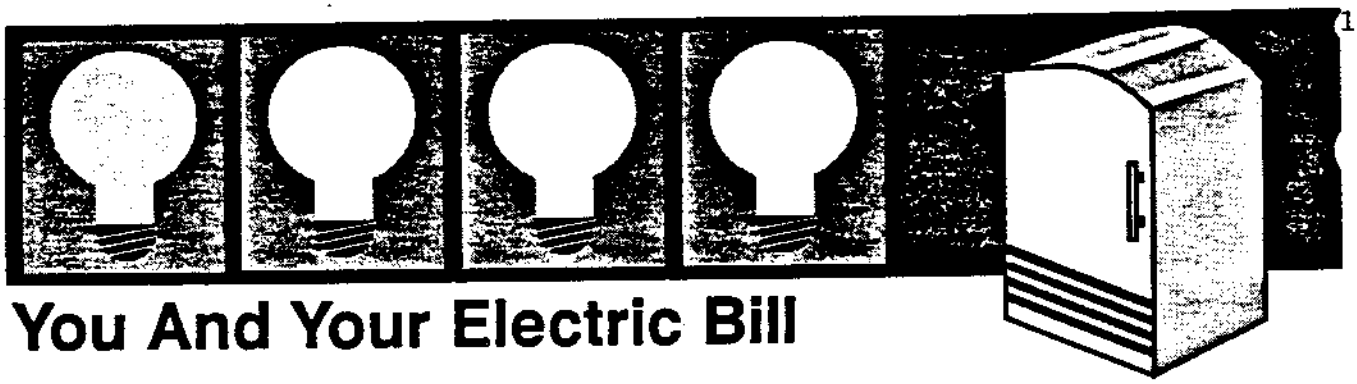
Assume that electricity costs you 5 cents for one kilowatt hour. How much would it cost to run the following: (see the sample below)

1. A 1000 watt light bulb for 2 hours _____
2. A 100 watt light bulb for 24 hours _____
3. A 50 watt stereo for 10 hours _____
4. A 1000 watt refrigerator for 24 hours _____
5. A 2000 watt air conditioner for 24 hours _____

SAMPLE: How much would it cost to run a 2000 watt clothes dryer for 3 hours if electricity costs 5 cents a kilowatt hour?

SOLUTION: 2000 watts = 2 kilowatts
2 kilowatts for 3 hours = 6 kilowatt hours (because 2x3 = 6)
6 kilowatt hours x 5 cents = 30 cents (6x5= 30)

SO: It costs 30 cents to run a 2000 watt clothes dryer for 3 hours.



You And Your Electric Bill

Answers:

Before you read this page, be sure you have read the page titled, **What Is A Watt?**

Look at the electric bill from your electric company. Who is your electric company? What do they charge for a kilowatt hour of electricity?

Let's suppose that it costs you 5 cents for 1 kilowatt hour. That means if you use 1000 watts (one kilowatt) for one hour you will use 5 cents worth of electricity!

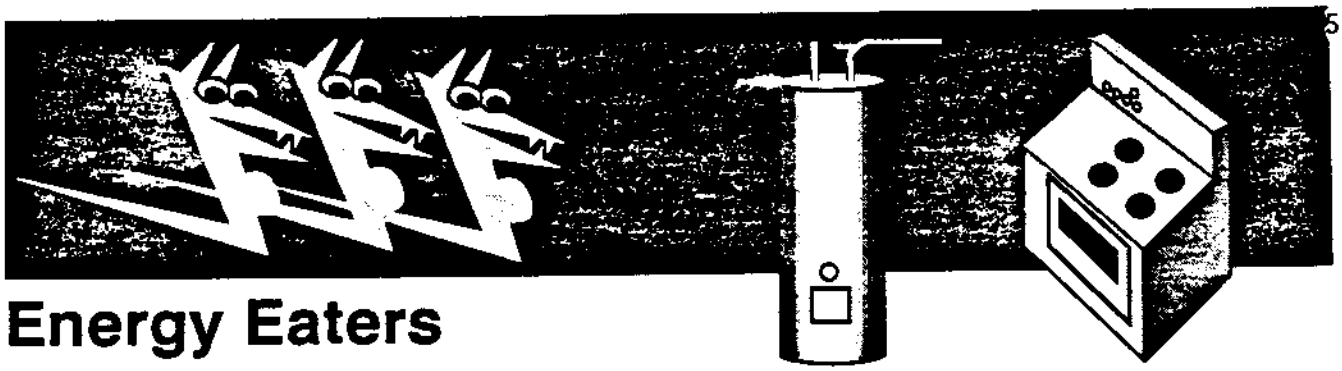
Assume that electricity costs you 5 cents for one kilowatt hour. How much would it cost to run the following: (see the sample below)

1. A 1000 watt light bulb for 2 hours **$.10**
2. A 100 watt light bulb for 24 hours **$.12**
3. A 50 watt stereo for 10 hours **$.025**
4. A 1000 watt refrigerator for 24 hours **$1.20**
5. A 2000 watt air conditioner for 24 hours **$2.40**

SAMPLE: How much would it cost to run a 2000 watt clothes dryer for 3 hours if electricity costs 5 cents a kilowatt hour?

SOLUTION: 2000 watts = 2 kilowatts
2 kilowatts for 3 hours = 6 kilowatt hours (because 2x3 = 6)
6 kilowatt hours x 5 cents = 30 cents (6x5= 30)

SO: It costs 30 cents to run a 2000 watt clothes dryer for 3 hours.



Energy Eaters

Some appliances in your home use a lot of electricity. We call these "energy eaters." They include: freezers, refrigerators, dishwashers, clothes dryers, heaters, air conditioners and hot water heaters.

Find some "energy eaters" in your home. How much electricity do they use? (it should be written on them somewhere)

List the "energy eater" and how much electricity it uses.

1. _____

2. _____

3. _____

4. _____

List Four Ways You Can Save Electricity And Save Your Parents Some Money Plus Help Conserve Our Natural Resources.

1. _____

2. _____

3. _____

4. _____

Energy Eaters

Answers:

Some appliances in your home use a lot of electricity. We call these "energy eaters." They include: freezers, refrigerators, dishwashers, clothes dryers, heaters, air conditioners and hot water heaters.

Find some "energy eaters" in your home. How much electricity do they use? (it should be written on them somewhere)

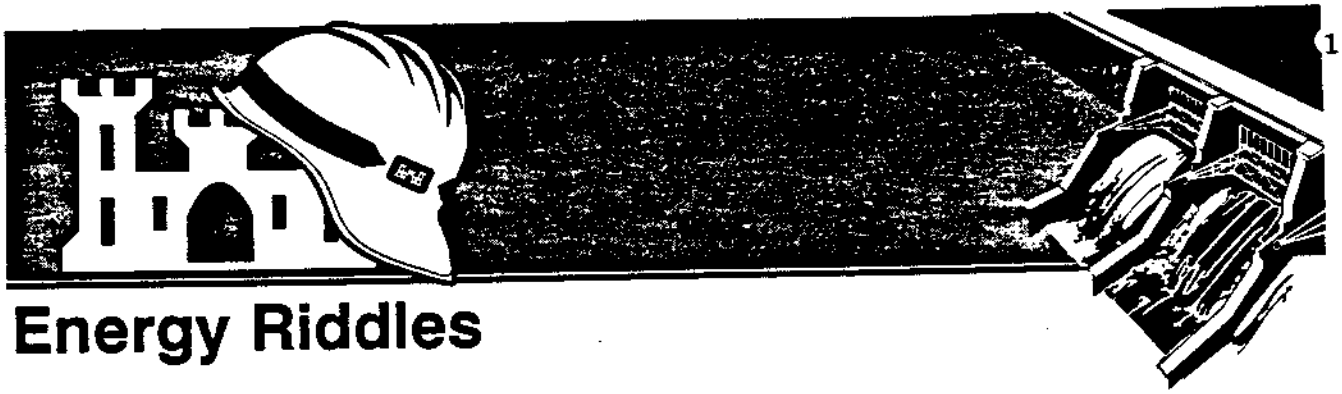
List the "energy eater" and how much electricity it uses.

Example:

1. range and oven — 12,000 watts
2. clothes dryer — 5,000 watts
3. air conditioner — 2,300 watts
4. water heater — 2,475 watts

List four ways you can save electricity and save your parents some money plus help conserve our natural resources.

1. **turn off lights and other appliances when done using them**
2. **turn thermostat down to 55 degrees at night and 68 degrees during the day**
3. **use air cooler in only one room**
4. **use alternatives to your oven such as, toaster or microwave**



Energy Riddles

We have included these riddles to help you become familiar with some hydropower vocabulary words.

I spin like a top, but I'm made of steel. Water makes me turn, like a giant pinwheel. What am I?

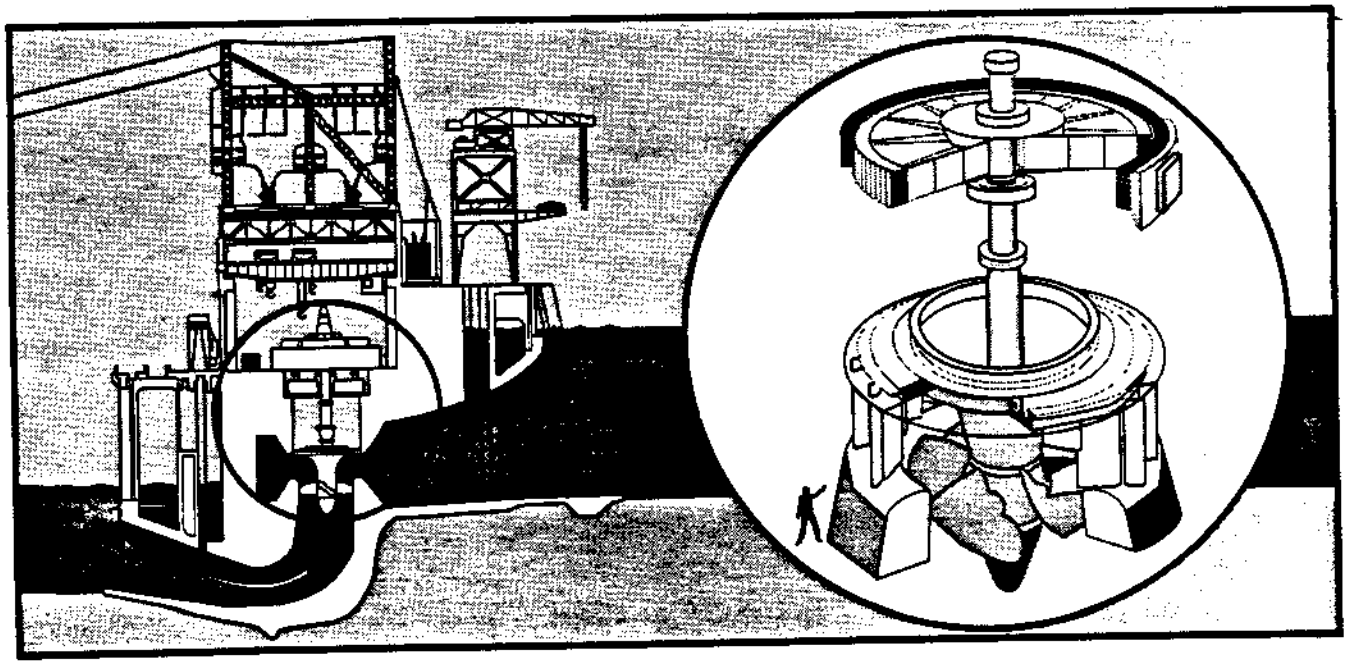
We built the dam you are going to see. We run it night and day to make electricity. Who are we?

I am a kind of energy sent through the lines. I am moving electrons to run things of all kinds. What am I?

I spin around and around for you see, my magnets move past coils of wire to produce electricity. What am I?

I'm part of a dam, and see me you will! I can hold water back, I can let water spill! What am I?

I'm the part of the dam, where power comes from. You can come inside me and hear my machines hum! What am I?



Energy Riddles

Answers:

We have included these riddles to help your students become familiar with some hydropower vocabulary words. The answer to each is written beside it.

I spin like a top, but I'm made of steel. Water makes me turn, like a giant pinwheel. What am I? – **a turbine**

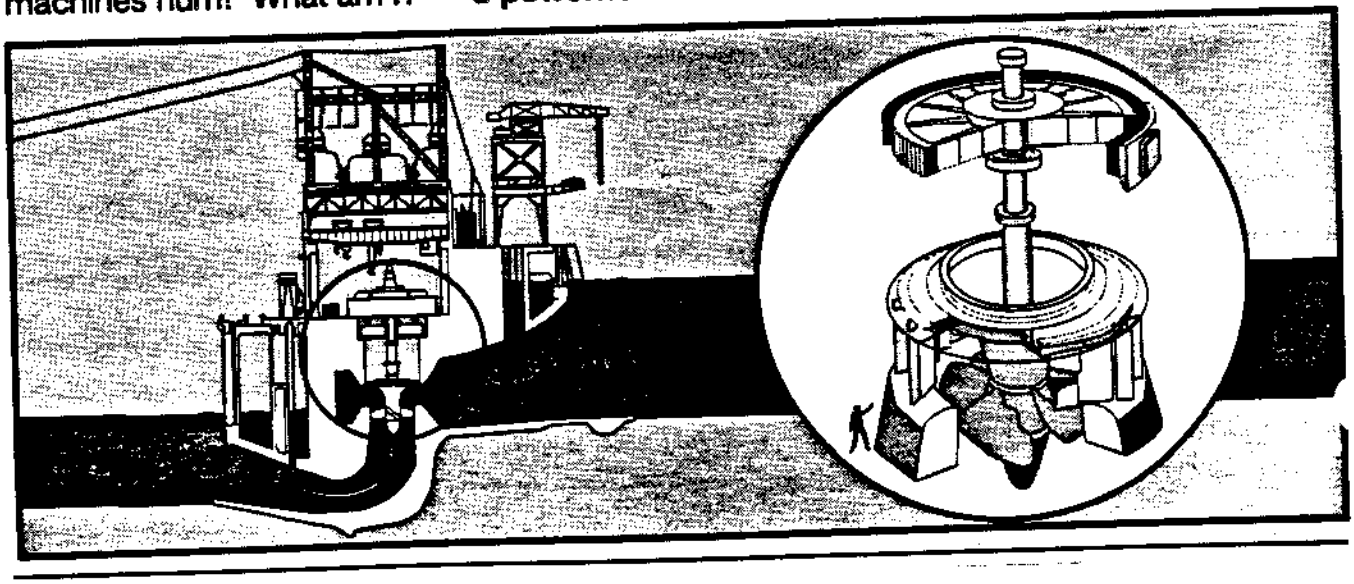
We built the dam you are going to see. We run it night and day to make electricity. Who are we? – **U.S. Army Corps of Engineers**

I am a kind of energy sent through the lines. I am moving electrons to run things of all kinds. What am I? – **electricity**

I spin around and around for you see, my magnets move past coils of wire to produce electricity. What am I? – **a generator**

I'm part of a dam, and see me you will! I can hold water back, I can let water spill! What am I? – **the spillway**

I'm the part of the dam, where power comes from. You can come inside me and hear my machines hum! What am I? – **a powerhouse**



Hydropower
During Your Visit

The activities in this section are intended for use during your visit to Bonneville Dam. They will give your students a chance to learn about electricity and the production of electricity at their own pace.

Activities

On Your Way To Bonneville Dam:

Ask your students to look for transmission lines, power poles and other things which have something to do with electricity.

What To Do At Bonneville Dam:

There are two powerhouses at Bonneville Dam. The first powerhouse is accessible from Oregon, the second powerhouse from Washington. The second powerhouse provides better access to the generators. It is possible to make reservations for a guided tour at both powerhouses. (503)374–8820

I Am A Copper Atom:

This activity has students model the production of electricity. It will require some pre-planning and some leadership from the teacher.

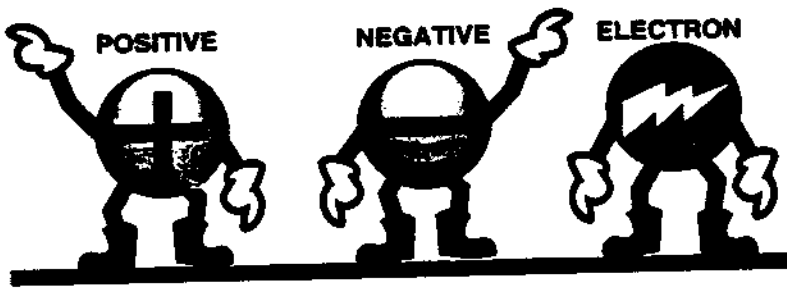
It will be helpful to do this activity prior to the following activities.

Electricity: From The Powerhouse To Your House
(Powerhouse One Version)

Every student, or group of students, will need a copy of this "self–guide" to the first powerhouse.

Electricity: From The Powerhouse To Your House
(Powerhouse Two Version)

Every student, or group of students, will need a copy of this "self–guide" to the second powerhouse.



I Am A Copper Atom

"I Am A Copper Atom" is a game in which you pretend you are generating electricity. It will require your teachers direction and explanation of what an atom and its parts are. Ask the rangers to let you know where a diagram of a generator is. The diagram can be a reference for understanding this activity.

Ask volunteers to make two circles, one inside the other. The outside group of volunteers pretend that they are electrons in the stator. The stator is coils of copper wire. The inside group of volunteers pretend that they are the rotor. The rotor consists of magnets which spin inside the stator.

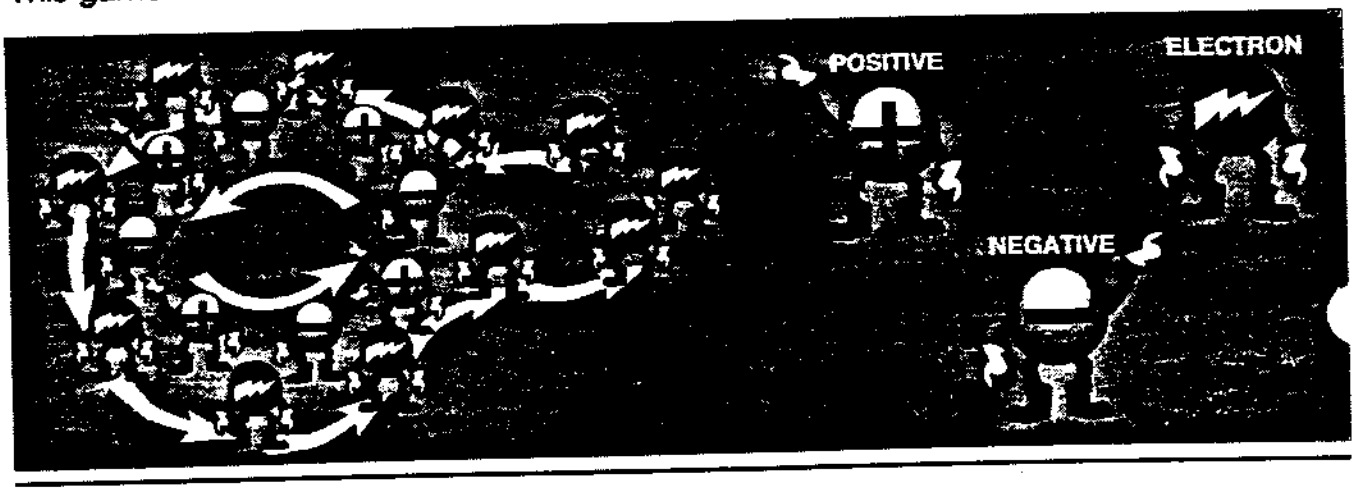
Water coming through the dam spins the turbine, which spins the shaft, that is connected to the rotor. The rotor spins around inside the stator. As the magnets of the rotor spin inside the stator, the electrons in the coils of copper wire become excited.

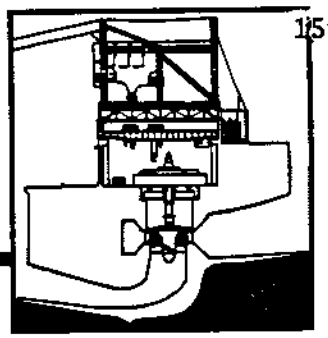
Those the inside group are magnets and those in the outside group are electrons in the atoms of the copper coils.

The inside group walks in a circle holding hands. Every other set of hands should be held up, this represents the positive poll. As the inside group walks around and the set of upheld hands comes by, each member of the outside group becomes excited and bumps the person next to them and stands in their place. When the teacher says "negative poll", the inside group will hold up the opposite set of hands, causing the outside group to bump their neighbor in the opposite direction.

After the current leaves the generators, it travels through transmission lines to get to our homes. You can add a transmission line. Two lines of students, with one on the end connecting the two lines, can be attached to the outside circle.

This game demonstrates alternating current (A.C.) electricity.





Electricity: From The Powerhouse To Your House! (First Powerhouse Version)

This is a "do it yourself" tour of the first powerhouse at Bonneville Dam. You will discover how electricity is made and how it is sent from the powerhouse to your house.

To get to the powerhouse, walk from the Bradford Island Visitor Center and follow the white arrows with the lightning symbols painted in them.

Stop #1 Look At The Large, Steel Turbine Blade.

This is just one of five turbine blades on each turbine! Imagine how much water it must take to turn each turbine. Every second, each turbine blade is struck by enough water to fill an average three bedroom house!

When the turbine spins, it causes the generator to spin. Go to the model of the generator next.

Stop #2 Spin The Generator!

What are the green coils?_____

What are the red and blue pieces of metal?_____

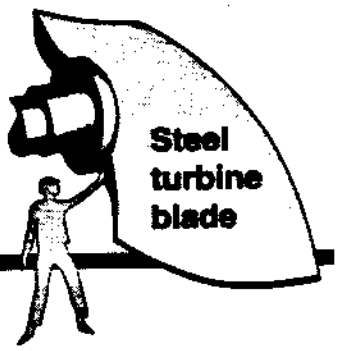
If you answered coils of wire, and magnets, you are really thinking! The real generators work just the opposite way with the magnets spinning around inside the coils of wire.

When the magnets spin inside the coils of copper wire, they cause the electrons (which are small parts of the atoms) in the coils of wire to get exited and move. The electron is pulled to a different atom and another electron jumps in to take its place. Pretty soon all the electrons are jumping from one atom to the next in a sort of "flow". This flow is electricity. You cannot see the electrons move but you can tell it is happening if you look at the gauge.

How many volts did you make?_____

Stop #3 Go To The Diagram Of The Powerhouse.

Look at the wires on top of the powerhouse in the drawing. After the electricity is generated, it is sent to wherever it is needed (maybe your house).



Most of the electricity used in the Northwest is made at dams.

Where do dams get their "fuel" to keep them going? Go to the exhibit labeled "THE WATER CYCLE AND ELECTRICITY" and find out.

Stop #4 Hydropower And The Water Cycle.

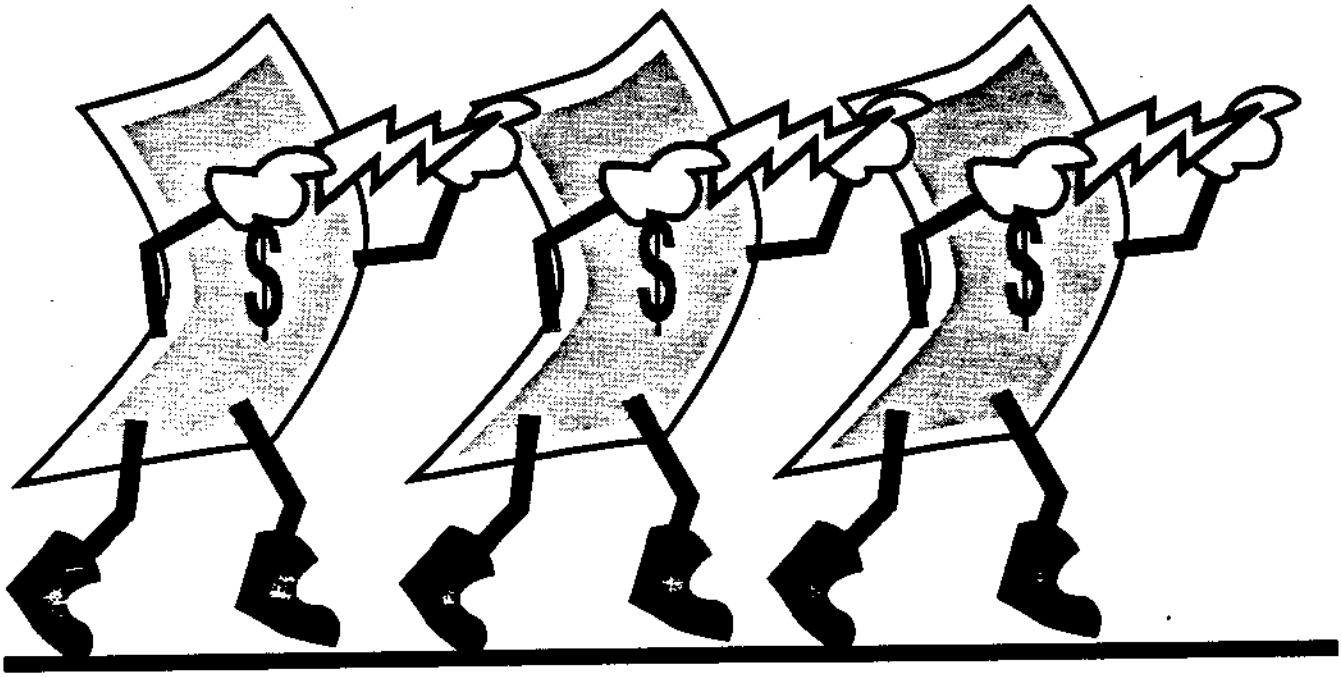
Stand behind the rotating discs and while spinning them, look at the display. You will see how water gets "recycled" by nature.

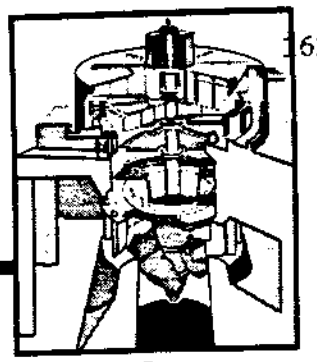
Stop #5 Have One More Look At The Generators.

If a light bulb uses 100 watts, can you figure out how many light bulbs you could light with all the generators in the powerhouse? Together, the generators in this powerhouse can generate 518,000,000 watts.

Stop #6 The Last Stop Of This Tour Is Your House.

That is where some of this electricity may go. We make a lot of electricity at Bonneville Dam. That does not mean you can waste it. You can see how we had to block the river to build this powerhouse which is not good for some fish and wildlife. The more electricity we use the more powerhouses we may have to build. You know that your parents must pay money for the electricity you and your family uses. Those are two good reasons to CONSERVE ELECTRICITY!





Electricity: From The Powerhouse To Your House! (Second Powerhouse Version)

This is a "do it yourself" tour of the second powerhouse at Bonneville Dam. You will discover how electricity is made and how it is sent from the powerhouse to your house!

Start In The Glass-walled Building (The Visitor Orientation Building). Go Up The Escalator And Cross The Skywalk Toward The Powerhouse.

Stop #1 On The Skywalk

In the middle of the skywalk, stop and look at the difference between the levels of the water upstream and downstream. (The water is about 60 feet higher on the upstream side.)

Stop #2 Go To The Display Gallery (Follow The Orange Carpet)

Look at the generators. How many are there?_____

How many are turned on?_____(look for the ones with lights lit up on top)

These generators make enough electricity to meet the electrical needs of about 110,000 homes for one year! Next learn how they work.

Stop #3 Go To The Generator Model

Turn the generator with your finger.

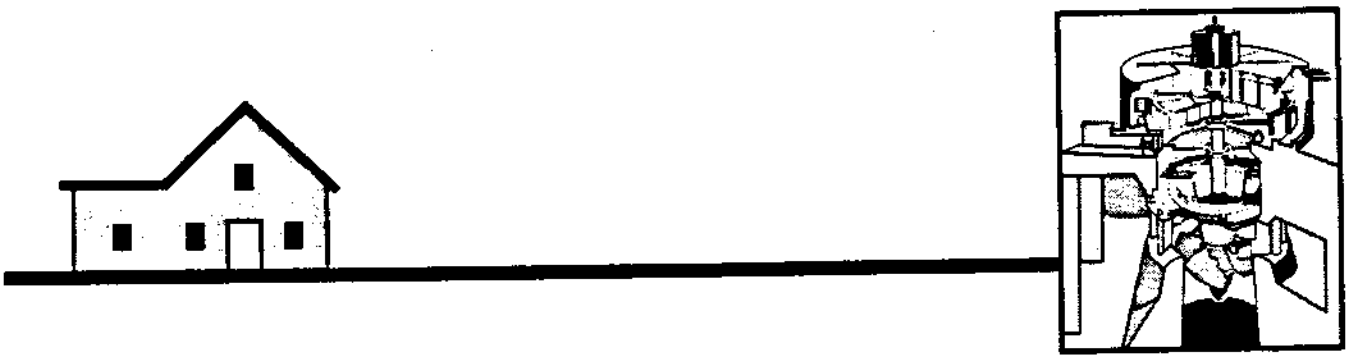
What are the green coils?_____

What are the red and blue pieces of metal?_____

If you answered coils of wire, and magnets, you are really thinking! The real generators work just the opposite way with the magnets spinning around inside the coils of wire.

When the magnets spin inside the coils of copper wire, they cause the electrons (which are small parts of the atoms) in the coils of wire to get exited and move. The electron is

_____



pulled to a different atom and another electron jumps in to take its place. Soon all the electrons are jumping from one atom to the next in a sort of "flow." This flow is electricity. You cannot see the electrons move but you can tell it is happening if you look at the gauge.

How many volts did you make?_____

Stop #4 Go To The Transformer Model.

Electricity is transformed before it leaves here. Transformers increase the voltage to give the electricity a "push" so it can travel to your house. A transformer is like the nozzle on your garden hose at home. What happens to the water in the hose as it passes through the nozzle? It comes out with more force. This is what a transformer does to electricity.

Stop #5 Look At The Water Cycle Display

Water is recycled by nature. This makes it a renewable resource.

Stop #6 Go To The "Power Planning" Display

The Bonneville Power Administration (B.P.A.) is a government marketing agency set up to sell the electricity produced on the Columbia River and elsewhere. Push the button and the transmission lines light up. The B.P.A. builds these transmission lines to get the electricity to the buyers.

Stop #7 The Last Stop Of This Tour Is Your House.

That is where some of this electricity may go. We make a lot of electricity at Bonneville Dam. That does not mean you can waste it. You can see how we have had to block the river to build this powerhouse which is not good for fish and wildlife. The more electricity we use the more powerhouses we will have to build. You know that your parents must pay their electric bills. Those are two good reasons to CONSERVE ELECTRICITY!

You can continue on down through the powerhouse by following the arrows painted on the floor beginning through the double doors on the other side of the gallery.

Hydropower

After Your Visit

In this section, you will find activities to be completed after your visit to Bonneville Dam. These activities are intended to reinforce vocabulary and important concepts learned earlier.

Activities

Fill In The Energy Blanks:

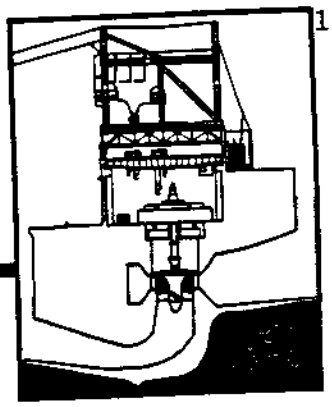
This activity works well either for individuals, small groups or large groups. If done individually, every student will need a copy.

The Water Cycle And Energy Relay Race:

If you have some active students, this game may be a good alternative way of teaching the important concepts of a recyclable resource and transfer of energy.

Different Ways To Generate Electricity:

You may want your students to understand that waterpower is not the only resource used to power generators that make electricity. To facilitate this understanding you could ask students to write a small paper on forms of energy used to run generators that make electricity and the trade-offs associated with each.



Fill In The Energy Blanks

Fill in the energy blanks. Use each word from the list only once.

Word List:

salmon
Bonneville Power Administration
powerhouse
magnets
electricity
conserve
U.S. Army Corps of Engineers
generator
turbines
kilowatt hours
hydropower

_____ is a form of energy. When it is produced at a dam, it is often called _____, which means water power.

When electricity is generated at a dam, water must fall through the dam and strike the _____ causing these pinwheel–like machines to turn. When these large machines turn, they cause a part of the _____ to spin and generate electricity.

Generators make electricity by spinning _____ past coils of copper wire. After electricity is generated in the _____ (which is the building at the dam where electricity is generated) it is sent through power lines to your house.

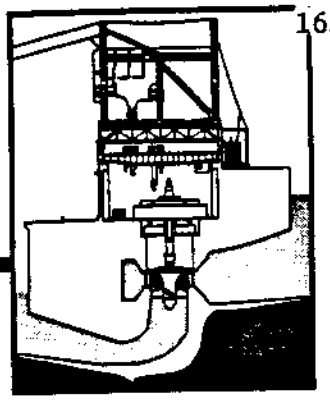
The dam is operated by the _____ which is a part of the federal government that builds dams, navigation locks, harbors, and other water–related structures.

When electricity leaves the dam, it becomes the responsibility of another part of the government called the _____. This agency may sell electricity to your power company.

Your electric power company charges you according to how many _____ you use. A kilowatt is 1,000 watts and if you use that much electricity for an hour it is called a kilowatt hour.

Generating electricity at a dam is clean and does not use coal or oil, which are in limited supply. One of the major disadvantages to generating electricity at Bonneville Dam is that it makes life difficult for _____ which must get past the dam twice during their lives.

Remember to _____ or use less electricity whenever you can!



Fill In The Energy Blanks

Answers In Order:

electricity
hydropower
turbines
generator
magnets
powerhouse
U.S. Army Corps of Engineers
Bonneville Power Administration
kilowatt hours
salmon
conserve

Electricity is a form of energy. When it is produced at a dam, it is often called **hydropower**, which means water power.

When electricity is generated at a dam, water must fall through the dam and strike the **turbines** causing these pinwheel-like machines to turn. When these large machines turn, they cause a part of the **generator** to spin and generate electricity.

Generators make electricity by spinning **magnets** past coils of copper wire. After electricity is generated in the **powerhouse** (which is the building at the dam where electricity is generated) it is sent through power lines to your house.

The dam is operated by the **U.S. Army Corps of Engineers** which is a part of the federal government that builds dams, navigation locks, harbors, and other water-related structures.

When electricity leaves the dam, it becomes the responsibility of another part of the government called the **Bonneville Power Administration**. This agency may sell electricity to your power company.

Your electric power company charges you according to how many **kilowatt hours** you use. A kilowatt is 1,000 watts and if you use that much electricity for an hour it is called a kilowatt hour.

Generating electricity at a dam is clean and does not use coal or oil, which are in limited supply. One of the major disadvantages to generating electricity at Bonneville Dam is that it makes life difficult for **salmon** which must get past the dam twice during their lives.

Remember to **conserve** or use less electricity whenever you can!

The Water Cycle And Energy Relay Race

Materials:

This activity consists of three phases. A discussion phase; an active phase and another discussion phase. Materials needed are: identical shallow bowls or spoons or anything in which it is difficult to carry water!

Briefly discuss the water cycle and it's importance to hydroelectric production. Good questions include: Where does the energy come from which powers the water cycle? (sun, gravity) What makes water evaporate? (the sun) Where does the water go? (it eventually condenses and rains) How does it get to the river? (run-off from the land) What makes the water flow in the river and through the powerhouse? (gravity)

By discussing the above questions, you have come to understand that the water moves through the powerhouse because of gravity. Everybody knows that water flows downhill but not everyone realizes that hydroelectricity is made possible by gravity. As the water falls through a powerhouse, the gravity energy is changed to mechanical energy. This takes place when water strikes the turbine blades causing rotation of the turbines. The turning turbines are attached to generators. Therefore, as the turbine spins, so does the generator. The mechanical energy of the turbine is changed to electrical energy as the magnets of the rotor are spun past the coils of copper wire in the stator. The transformer increases the voltage so electricity may be sent more efficiently through transmission lines. The transmission lines usually take it to another transformer which decreases voltage again and it is then sent to homes and businesses for people to use. This sequence should be quickly explained to the group before the next phase of this activity.

For the active phase, divide the group into teams of seven people each. Any "leftover" people can help decide the winner. The seven people in each team will represent **1.** river; **2.** turbine; **3.** a generator; **4.** a transformer; **5.** a transmission line; **6.** a transformer in their neighborhood; **7.** a light bulb. Each team should be arranged as shown just before the race begins.

Every player should have an identical container in which to carry water. The best containers are spoons or anything which is likely to spill. Get the teams into the starting positions and fill the first player's (the person in each team that represents the the river) container as full as possible. Water will symbolize energy. In this relay race, the winner will

be the team with the most water at the end of the race! That team has "saved the most energy!"

To start, the first player must race to the second player and "transfer" the energy (water) to that person. The second player races to the third and so on until the water (if there is any left) is "transferred" to the last player, the light bulb.

Next, congratulate the team who has saved the most energy (the team with the most water). Discuss how energy is lost in the form of heat every time it is transferred. This game illustrates the second law of thermodynamics which, simply stated, says that whenever energy is transferred, some is lost in the form of heat. Heat, of course, radiates away from the earth and approximately equals what comes in from the sun. Discuss the importance of conserving energy.

Navigation
An Introduction

Boats can pass Bonneville Dam on their way up or down the Columbia River by using the navigation lock. This subject area is designed to familiarize students with the navigation locks and inland trade.

The first section includes activities for the classroom intended to introduce the subject of navigation to your students. Next, are activities that can be conducted at Bonneville Dam while visiting the navigation lock. Finally, there are activities included to reinforce what has been learned.

History Quickie

When Bonneville Dam was built it greatly facilitated navigation. Bonneville Dam flooded the Cascade Rapids that were just behind it. The Bonneville lock, at the time it was built, was the largest single lift lock in the world. The dam flooded the lock at Cascade Locks, Oregon (previously called Whiskey Flats).

Important Concepts

The activities in this section will help the students understand the following concepts. Important vocabulary words are in bold print.

Navigation Locks

The first Bonneville **navigation lock** was constructed between 1933 and 1938. The old lock is 500 feet long, 76 feet wide and 24.2 feet deep above the sill with an average lift of 60 feet. The construction used 105,000 cubic yards of cement and 2,700,000 lbs. of structural steel.

There is a **lock operator** on duty 24 hours a day, 365 days a year. **Lockages** are provided at no charge for all **watercraft** including; military, commercial, and pleasure craft. Commercial craft do however pay a fuel tax that goes into the Waterways Trust Fund which is used to maintain waterways and is helping fund construction of the new navigation lock at Bonneville Dam.

There are strict priorities that guide the operation of federal locks, providing the highest priority for military craft, second highest to commercial craft, and a lowest priority for pleasure and recreational craft. This means pleasure craft may be asked to wait up to three hours or more during busy periods. Often, pleasure craft will be locked through with non- hazardous barge loads, usually a tug and two barges at Bonneville. This is done to conserve the large amounts of water used to operate the lock and expedite lockages.

When a boat is ready to go through the lock, **vessels** with a marine radio can call the **lock operator** and request passage. Those vessels without a radio can speak to the lock operator via the speaker on the entrance wall.

The lock is a simple way of passing boats from one elevation to another. It is like an elevator but uses water. Water fills and empties from the lock by **gravity flow**.

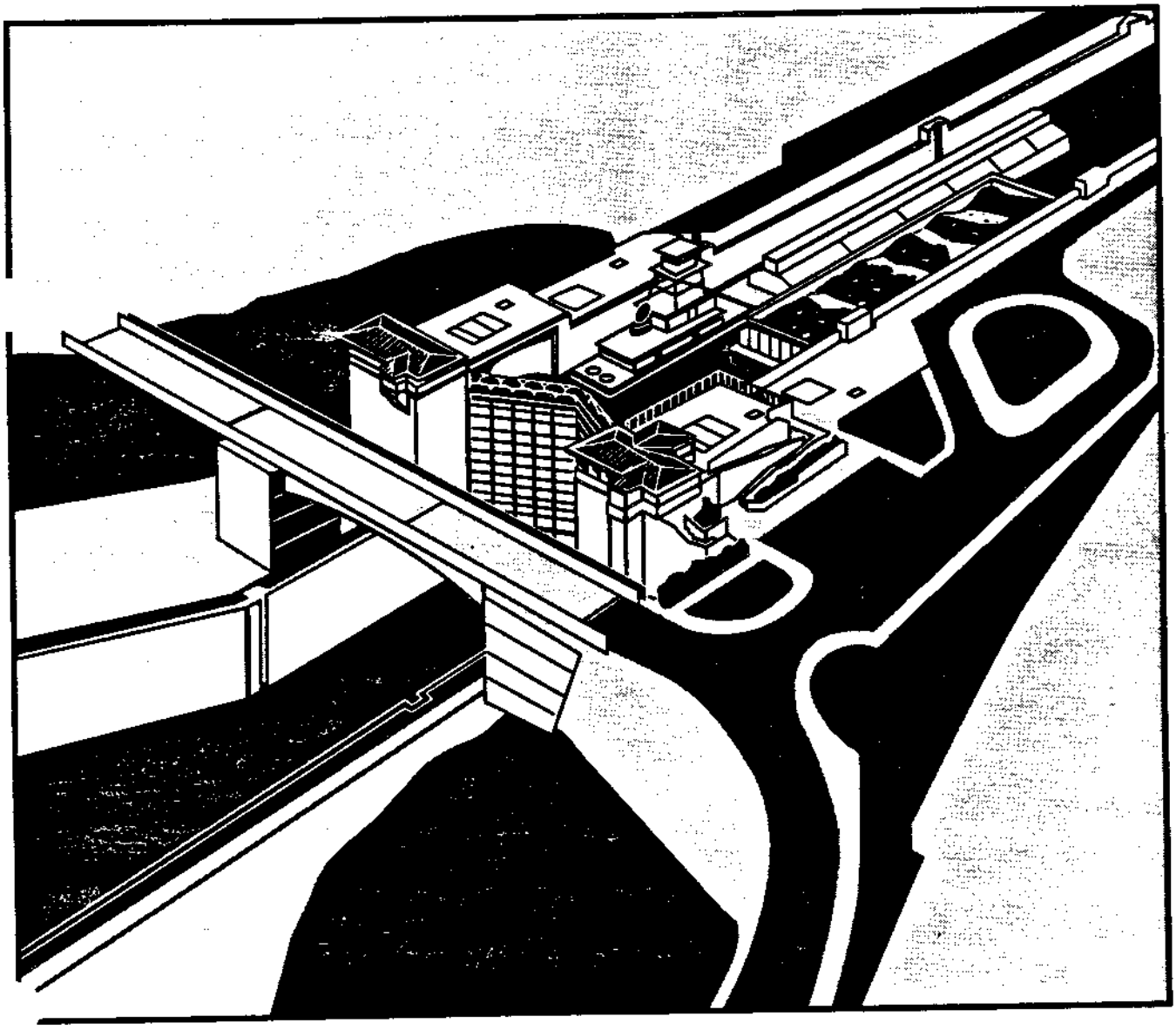
It takes about 15 minutes to either fill or drain the lock. Allowing for time to enter, tie the craft to a **floating mooring** bit, then later to untie and leave the locks, the entire lockage process takes about 30 to 35 minutes. The average lift is 60 feet, with a minimum of 30 feet and a maximum of 70 feet. Each lockage uses about 17 million gallons of water, or enough water that if passed through a generator would supply the electrical energy needs of one Northwest home for a year.

The lock at Bonneville is the busiest lock on the Columbia- Snake river system. More than 10 million tons of cargo pass through Bonneville's lock each year. Frequent cargoes moving upriver include petroleum, oil, gasoline, and fuel oil. **Barges** going **downstream** contain cargoes such as barley, wheat, oats, and other grains, wood products and building materials. River navigation is possible as far inland as Lewiston, Idaho, some 480 miles from the ocean and an elevation change of about 740 feet.

New Navigation Lock

The new navigation lock was completed in 1993. The old lock at Bonneville Dam, completed in 1938, was the first and the smallest of eight locks built on the Columbia–Snake Inland Waterway. Construction of a new navigation lock is very important to the region, to improve the speed and safety of navigation on the river.

The new lock is 175 feet longer and 10 feet wider than the old lock. It increased the commercial shipping capacity at Bonneville to 30 million tons a year. That should be large enough to handle increases in shipping projected for the next 50 years.



Navigation
Before Your Visit

This section consists of activities designed to prepare your class for their visit to the Navigation Lock at Bonneville Dam.

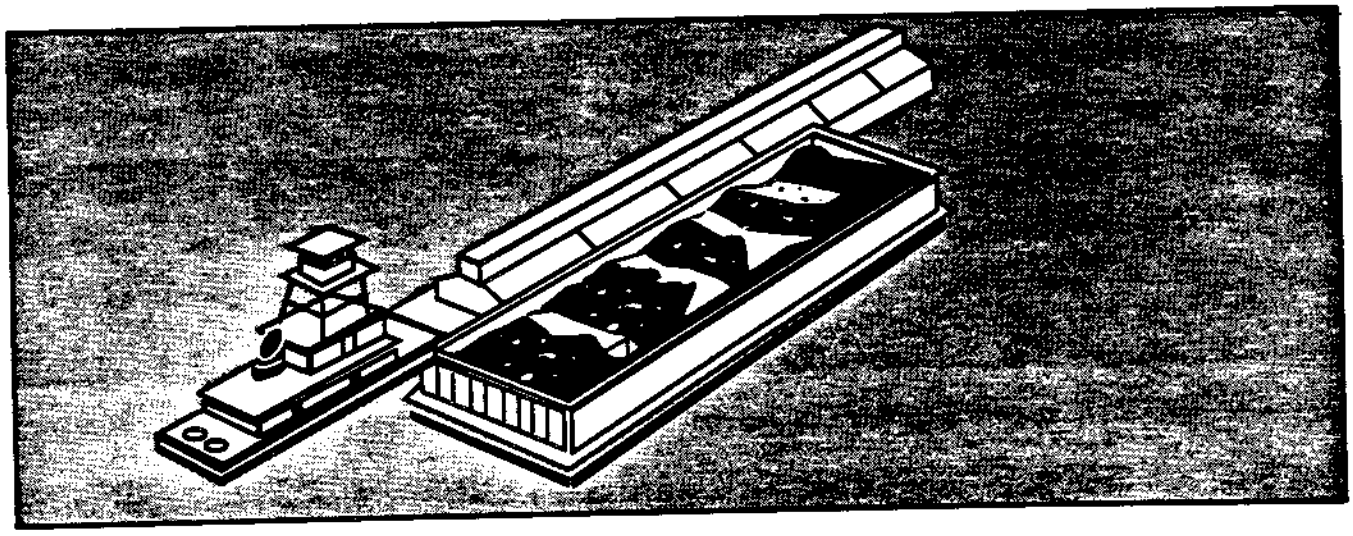
Activities

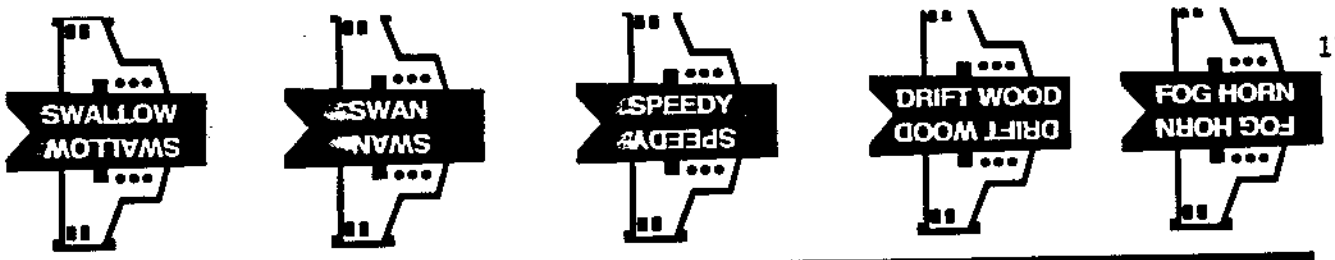
The River Navigation Game:

By playing this game your students will get a good idea of how a lock works and how it is used. You will need to make one copy of the game for every four students.

Columbia River Navigation:

This is a problem solving activity designed for groups. It will be useful in explaining why locks are needed.





The River Navigation Game

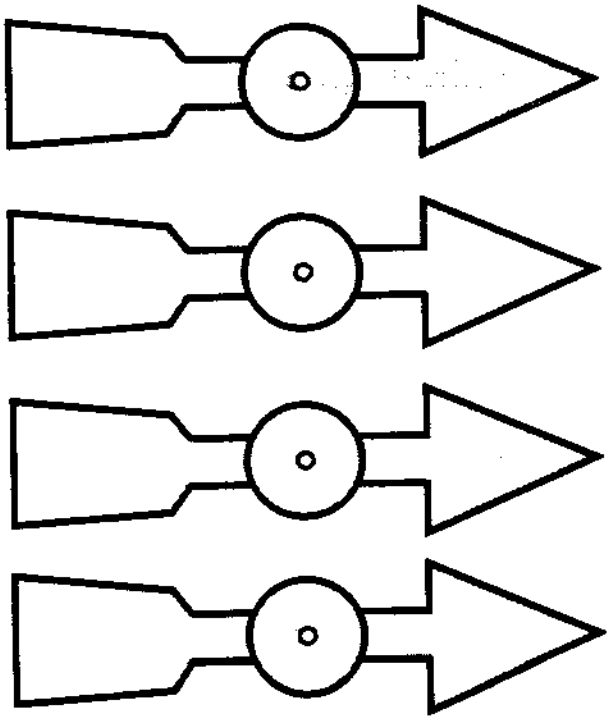
This game will familiarize you with some of the complexities of river navigation, including passage through a lock.

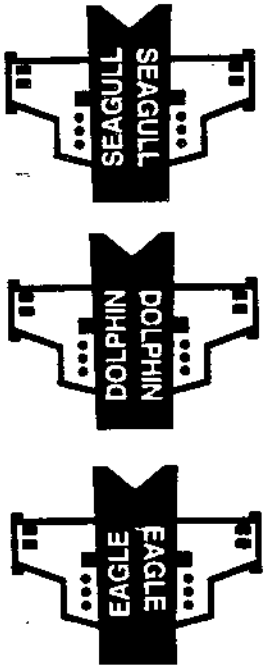
Visits to the lock do not always coincide with the times when the lock is being used. This game will help you understand the process of passage through a lock, even if the lock is not operating.

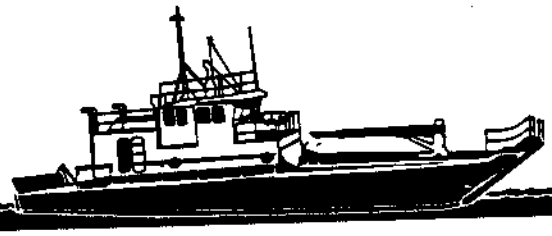
To Play This Game:

1. Color the game board and spinner, arrow, and tugboats.
2. Cut them out with scissors.
3. Paste them to cardboard.
4. Attach the arrow to the spinner by piercing the center of both with a pin.

TO PLAY: Players spin the spinner to determine who will play first. The player who spins the highest number takes the first turn. Play should then proceed in a clockwise direction. All players should start their boats on the space labeled, "start." The winner is the first player who navigates back and forth through the locks and arrives at the space labeled, "finish." Movement "up and down the river" is determined by the number on the spinner and by the hazards and opportunities encountered along the way.







The Sandwick - a small dredge

Columbia River Navigation: Problem Solving

Conduct this activity by dividing the class into groups. Every group should "brainstorm" solutions for every problem and all of the solutions should be written on the blackboard at the end of the brainstorming session.

Brainstorming involves thinking of as many solutions as possible for a problem. No judgments should be passed during this phase. The goal is to collect alternatives. Later, after all of the solutions have been collected for a problem, the advantages and disadvantages should be discussed. The solution with the fewest and least important disadvantages and most important advantages is usually the best alternative.

Here are some navigation problems:

PROBLEM 1. **In the past huge sand bars formed at the mouth of the Columbia River. Many ships ran aground. How would you solve this?**

SOLUTION: _____

_____

PROBLEM 2. **During the 1800's, huge rapids called the Cascades of the Columbia River made it difficult for boats to navigate the Columbia River. How would you solve the problem of improving extremely important river transportation?**

SOLUTION: _____

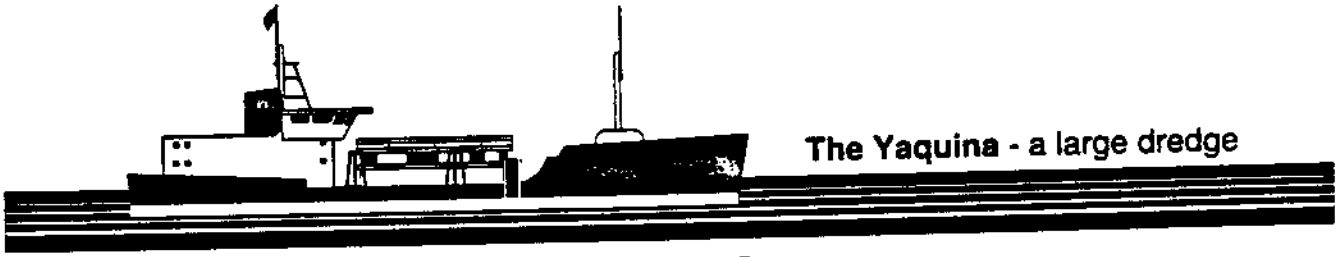
_____

PROBLEM 3. **You want to find an inexpensive way to move bulky items back and forth between the mouth of the Columbia River and places upriver as far as Lewiston, Idaho. Due to many rapids, the river is not completely navigable.**

SOLUTION: _____

_____

_____



The Yaquina - a large dredge

Columbia River Navigation: Problem Solving

Answers:

Conduct this activity by dividing the class into groups. Every group should "brainstorm" solutions for every problem and all of the solutions should be written on the blackboard at the end of the brainstorming session.

Brainstorming involves thinking of as many solutions as possible for a problem. No judgments should be passed during this phase. The goal is to collect alternatives. Later, after all of the solutions have been collected for a problem, the advantages and disadvantages should be discussed. The solution with the fewest and least important disadvantages and most important advantages is usually the best alternative.

Here are some navigation problems. We have listed the solutions which were chosen by the Corps of Engineers to deal with the problems. Both the problem and its solution have been listed.

PROBLEM 1. In the past huge sand bars formed at the mouth of the Columbia River. Many ships ran aground. How would you solve this?

SOLUTION: **The Corps of Engineers dredges the channel and builds jetties to block sand accumulation at the mouth of the river.**

PROBLEM 2. During the 1800's, huge rapids called the Cascades of the Columbia River made it difficult for boats to navigate the Columbia River. How would you solve the problem of improving extremely important river transportation?

SOLUTION: **The Corps of Engineers helped build a lock near the present location of Cascade Locks. Later, when Bonneville Dam was built, the water rose above the rapids, eliminating them. The Bonneville lock replaced the lock at Cascade Locks.**

PROBLEM 3. You want to find an inexpensive way to move bulky items back and forth between the mouth of the Columbia River and places upriver as far as Lewiston, Idaho. Due to many rapids, the river is not completely navigable.

SOLUTION: **The Corps of Engineers built four dams with locks on the lower Columbia and four dams with locks on the lower Snake River. The dams caused the water to cover the rapids, making the river navigable.**

Navigation During Your Visit

The following are some suggestions for studying navigation at Bonneville Dam.

The locks are accessible from the Oregon side of the dam. Exhibits at the lock explain its use.

If you are visiting the Washington side, see the lock operator exhibit on the main floor of the Orientation building. Push the button, pick up the phone and listen to information about navigation locks.

Activities

On Your Way To Bonneville Dam:

Ask your students to look for and identify boats that may be heading for the lock. You may also be interested in seeing the remains of the lock at Cascade Locks. This lock, located in the Cascade Locks Marine Park, was built by the Corps of Engineers. It was flooded in the 1930's when the Bonneville Lock and Dam was completed.

Look At A Lock:

Displays at the navigation lock have information about how boats go through the lock. This activity allows your students to use their imagination to discuss the process of using a lock.

Scavenger Hunt:

This activity will help students identify the different parts of the lock and what they are used for.

Look At A Lock

The lock at Bonneville Dam may be thought of as a water-filled elevator which is used by boats to get past the dam. Water enters or leaves the lock through large valves located in the bottom of the lock. No pumps are needed because gravity moves the water in and out of the lock. To fill the lock, the intake valve is opened and water flows into the lock. To drain the lock, a drain valve is opened and water flows out of the lock. It is thought that the amount of water used for one lockage could, if passed through turbines, generate enough electricity to meet the electrical energy needs of one home for one year!

Walk up to the lock viewpoint. Imagine that a ship is coming. Explain, step by step, how you will help the ship through the lock. Volunteer to explain the first step in the process of locking through. Continue the process with other volunteers until the entire lockage sequence has been explained.

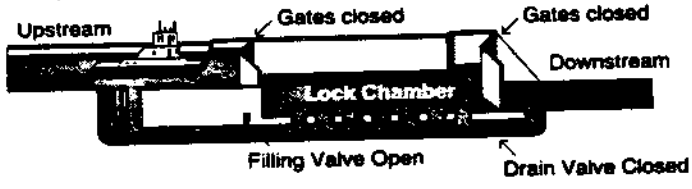
How It Works

A boat operator coming upriver will radio the lock master and announce when they expect to be at Bonneville Dam. The lock master will open the downstream gates and turn on a green signal light so the boat operator knows the lock is ready to enter. A red signal light tells the boat operator the lock is not ready. The boat will enter the navigation lock and tie up to the floating mooring bits. The lock master will then close the gates and open the upstream water valve to fill the lock. The water has to rise an average of 60 feet, this is the difference in the water level above and below the dam. Pumps are not needed; the force of gravity does all the work. When the lock is full the upstream gate is opened and the boat exits upriver.

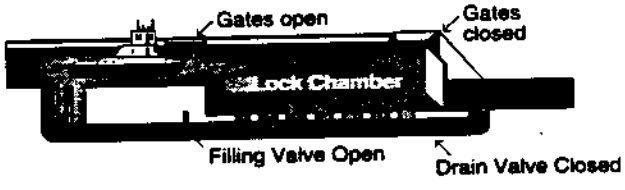
Boats going downstream use the same process except that the water is drained from the navigation lock.

Lock Operation

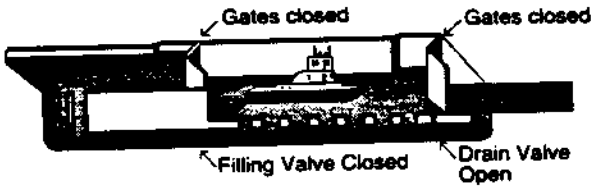
1 Tow waiting to enter lock chamber
(Lock Chamber filling)



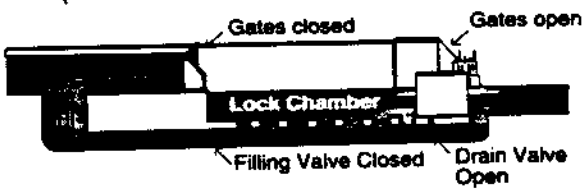
2 Tow enters lock chamber
(Lock Chamber filled)



3 Tow in lock chamber
(Lock Chamber draining)



4 Tow proceeds downstream
(Lock Chamber drained)



Scavenger Hunt

This activity will describe some of the more obvious equipment used while operating a navigation lock. Can you find the particular piece of equipment? The first one to find it gets a point. You can double your point if you can explain what the equipment is used for. If you find it and are unable to explain what it is used for, then the first person who can, gets the point.

Here Are Some Objects To Look For:

Gates: The huge metal gates of the lock are hydraulically controlled and weigh about 260 tons a piece.

Floating Mooring Bits: Located in slots on the inside of the lock, these are the devices that the boats may be tied to. The water level changes in the lock (usually 60 feet) so these mooring bits must float. If they did not float, any boat attached firmly to them would either be suspended above the water or held under water as the water level changed.

Traffic Lights: Like traffic lights on roads, these lights tell the pilot of a boat when to stop or when to proceed.

Stoplogs: These steel reinforced structures are to prevent water from flowing into the lock when the gates are being repaired.

Office: This is where the lock operator works, controlling the gates and valves that let water in and out and receiving messages that boats are coming and would like to use the lock.

Navigation
After Your Visit

These activities are designed to encourage students to review what they learned about the navigation lock.

Activities

Lock Operator:

This is an activity involving matching words with their definitions. It deals with the information a lock operator must have.

Word Association Game:

This game is intended to stretch the students' vocabulary. They must think of words that start with particular letters and are associated with navigation or watercraft.

Did You Know:

This is a short quiz on navigation.

Lock Operator

The following is some of the information that a lock operator must know to operate a lock at Bonneville Dam. See how much you know about the lock and about navigation on the Columbia. Write the number of the word in front of the correct definition.

1 Barge	_____a deep trench in the river bottom dug for safe passage of boats
2 Channel	_____one definition of this word "to travel on water"
3 Corps Of Engineers	_____a special boat that digs channels in rivers
4 Dredge	_____a long pile of rocks that make a wall out into the ocean; used to prevent unwanted sand deposits at the mouth of a river
5 Floating Mooring Bit	_____an "elevator" for boats, this elevator uses water to raise or lower boats
6 Grain And Wood	_____a part of a lock used to tie boats to; it floats
7 Jetty	_____a large, floating box-shaped boat which is used to move very bulky cargo
8 Lewiston, Idaho	_____a powerful boat which is used to move barges
9 Lock	_____this is how far inland a tug may take a barge
10 Navigate	_____two cargoes which are sent up the Columbia River
11 Oil And Fertilizer	_____two cargoes that are sent down the Columbia River
12 Tug Boat	_____the government agency which built and operates the locks on the Columbia River

Lock Operator

Answers:

The following is some of the information that a lock operator must know to operate a lock at Bonneville Dam. See how much you know about the lock and about navigation on the Columbia. Write the number of the word in front of the correct definition.

2 **Channel** – a deep trench in the river bottom dug for safe passage of boats

10 **Navigate** – one definition of this word "to travel on water"

4 **Dredge** – a special boat that digs channels in rivers

7 **Jetty** – a long pile of rocks that make a wall out into the ocean; used to prevent unwanted sand deposits at the mouth of a river

9 **Lock** – an "elevator" for boats, this elevator uses water to raise or lower boats

5 **Floating Mooring Bit** – a part of a lock used to tie boats to; it floats

1 **Barge** – a large, floating box-shaped boat which is used to move very bulky cargo

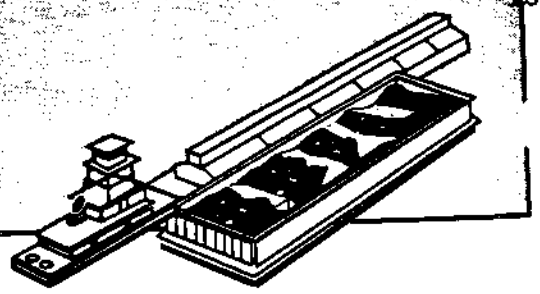
12 **Tug Boat** – a powerful boat which is used to move barges

8 **Lewiston,Idaho** – this is how far inland a tug may take a barge

11 **Oil And Fertilizer** – two cargoes which are sent up the Columbia River

6 **Grain And Wood** –two cargoes that are sent down the Columbia River

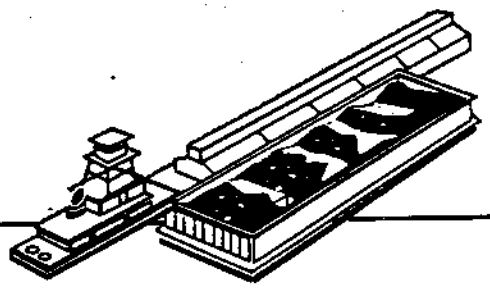
3 **Corps Of Engineers** – the government agency which built and operates the locks on the Columbia River



Word Association Game

To play this game you must think of a word that relates to both the Columbia River and to navigation lock or watercraft. The word must start with a letter in the word "Columbia" which is written vertically on the page. For instance; the letter "C" in Columbia will have two words that start with the letter "C" and associate with either navigation lock or watercraft, horizontally next to it. There are no incorrect answers as long as the answer can be explained.

	Navigation Lock	Watercraft
C		
O		
L		
U		
M		
B		
I		
A		



Word Association Game

Example For Teachers:

To play this game you must think of a word that relates to both the Columbia River and to navigation lock or watercraft. The word must start with a letter in the word "Columbia" which is written vertically on the page. For instance; the letter "C" in Columbia will have two words that start with the letter "C" and associate with either navigation lock or watercraft, horizontally next to it. There are no incorrect answers as long as the answer can be explained.

	Navigation Lock	Watercraft
C	cargo	commercial
O	operator	ocean liner
L	lumber	loaded
U	up river	untie
M	mooring bits	move
B	boats	barges
I	inside	inland trade
A	Army Corps of Engineers	agricultural products

Did You Know?

Did you know that if the water which is used for filling the lock were passed through a turbine, it would make enough electricity to meet the electrical needs of a home for one year! The new navigation lock can conserve water by passing the same amount of barges by the dam in one lockage that the old lock passed in five lockages.

The water to fill the lock comes from _____.

The water drained from the lock goes _____.

Why are locks necessary for river transportation? _____

_____.

Why is river transportation important? _____

_____.

How is a lock like an elevator? How is it different? _____

_____.

How is a lock like your bathtub? How is it different? _____

_____.

How else is the water from the Columbia River used? _____

_____.

What does "conserve" mean? _____

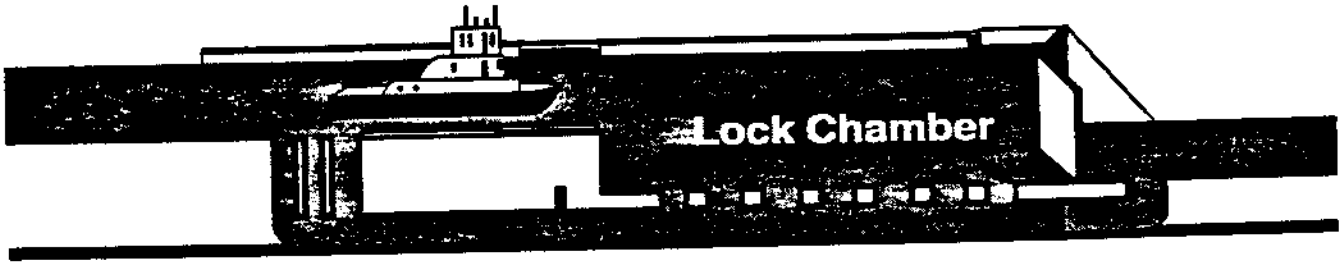
_____.

Why is it important to conserve the water in the Columbia River? _____

_____

_____.

_____



Did You Know?

Answers:

Did you know that if the water which is used for filling the lock were passed through a turbine, it would make enough electricity to meet the electrical needs of a home for one year! The new navigation lock can conserve water by passing the same amount of barges by the dam in one lockage that the old lock passed in five lockages.

The water to fill the lock comes from **upriver.**

The water drained from the lock goes **downriver.**

Why are locks necessary for river transportation? **Locks are built so boats can get around dangerous rapids or past a dam.**

Why is river transportation important? **Goods are transported quickly, safely and economically on a river.**

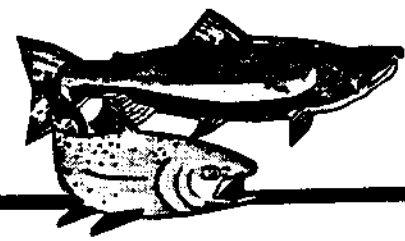
How is a lock like an elevator? How is it different? **A lock lifts boats from one elevation to another like an elevator. It uses water, an elevator doesn't.**

How is a lock like your bathtub? How is it different? **The lock is filled and emptied with the force of gravity upon water like a bathtub but the lock is much larger than a bathtub.**

How else is the water from the Columbia River used? **Columbia River water is used to make electricity, irrigate and for recreation. Fish and wildlife also use the Columbia River water.**

What does "conserve" mean? **To Conserve means to use something without destroying it.**

Why is it important to conserve the water in the Columbia River? **The Columbia River water is used for many important things.**



Natural Resource Management
An Introduction

The purpose of this subject area is to introduce your students to the subject of anadromous fish and provide a basic understanding of natural resources. Since hydropower dams like Bonneville Dam have changed the historic migration routes of salmon, steelhead, shad and other species, part of our natural resource management responsibilities include facilitating fish passage past the dam.

The first section includes activities to acquaint your students with the management of natural resources featuring anadromous fish. Next, are self-guided tours of the fish ladders on either side of the river, and the fish hatchery. Also included are charts for your students to use to keep track of the natural resources they might see while at Bonneville Dam. Finally there are activities included to reinforce what has been learned.

History Quickie

Throughout history and prehistory, Columbia River salmon have been harvested in many ways. In the 1870's contraptions known as fishwheels appeared on the Columbia River. These devices worked like waterwheels, capturing fish in scoop-like buckets and depositing them on a boat or platform. The fishwheels worked 24 hours a day and some were very successful, catching as many as 6,000 fish a day. Gill netting and perse seining were even more successfull methods of salmon harvest.

Over-harvesting was a major factor in the depletion of the salmon runs. Bonneville Fish Hatchery was built in 1909 to supplement the decreasing fish runs.

Fishwheels were outlawed in Oregon in 1926. The state of Washington followed suit in 1934. There is a model of a fishwheel on display in the Fish Viewing Building at the visitor center on the Washington side of the project.

Important Concepts

The activities in this section will help the students understand the following concepts. Important vocabulary words are in bold print.

Natural Resources

A **natural resource** is something found in nature that can be useful to people in some way. Humans have the power to change, use, take care of, or destroy natural resources. People also are dependent on natural resources so it is to our benefit to manage natural resources wisely.

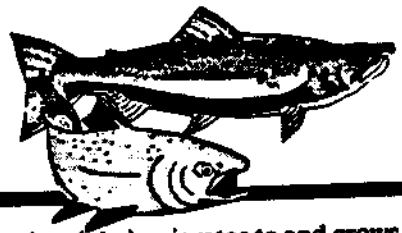
A natural resource can be living or non-living. A couple of the non-living natural resources found at Bonneville Dam are water and air. Some of the living resources found near Bonneville Dam are: anadromous fish, osprey, Canada geese, deer and elk.

Natural resources are **interdependent**; they are connected together and interact to form what we call the natural **environment**. When one natural resource is changed it affects all the others.

When we manage natural resources we must think about how a change we make to one resource might affect other resources. We change a river to make hydropower. This change affects other natural resources that depend on the river. We need electricity, irrigation water and river transportation but we also need fish, birds, deer and other animals. Fish, wildlife and plants have adapted to the natural seasonal fluctuations of the river. Building a dam disrupts this natural pattern and steps must be taken to artificially duplicate nature or some way make up for the harm done. This is called natural resource management.

Anadromous Fish

Because dams effect the migration of **anadromous fish**, the Army Corps of Engineers is highly involved in finding ways to get them around dams safely.



An anadromous fish spends a part of its early life in fresh water (a river, creek or lake), migrates to and grows to adulthood in salt water (the ocean) and then returns to the same river, creek or lake to spawn. These fish are an important source of food for humans and other animals. These fish include salmon, steelhead trout, shad and lamprey.

In general, the Columbia River salmons' life cycle begins in the fall when the adults spawn in the same stream bed where they were hatched. An adult salmon can go 900 miles or more inland to spawn in a shallow, clear mountain stream that has a clean bed of gravel. The female makes a nest in the bed of gravel called a redd. There she lays her eggs. The male passes over the redd and fertilizes the eggs by releasing milt or sperm. Both male and female salmon die after spawning.

The eggs hatch in about six weeks and the little fish live and grow in the stream from 2 to 18 months. The little fish, called fingerlings, grow to about the size of a human finger. These fingerlings migrate to sea between the spring and late summer time runoff. A fingerling goes to sea and is called a smolt. A smolt's body is changing so that it can live in salt water. This is called smoltification.

After the smolts make it to the ocean they will spend one to five years there. Because there is a lot of food in the ocean they become very large. During their rearing time in the ocean, they become adults and something tells them they must return to the place where they were spawned. They return to the Columbia River and eventually to their spawning stream.

Scientists think the fish find their way back to that stream where they were reared by sensing the chemical composition of the water. This is much like our sense of smell or taste.

Steelhead and shad also return to fresh water to spawn but do not necessarily die afterward. Their life cycle is similar to salmon except that they can potentially spawn several times. Steelhead spawn in a shallow, clear mountain stream that features a clean, bed of gravel. Shad spawn mainly in the reservoirs (lakes) created by the dams.

Fish Facilities

Fish Ladders

The returning adults could not get around a dam if there were not fish ladders. The fish are attracted into the ladders through a series of entrances along the face of the powerhouse and at the edge of the spillway. Water from the lake is added to the ladder water to create a strong flow into the river downstream, which attracts fish up and into the fish ladders.. At Bonneville Dam they must swim up 60 steps, each step is 1 foot. Fish ladders were built during construction of Bonneville Dam.

The fish ladders have been modified several times in the last 50 years. The submerged orifices or holes in the weirs or walls of the ladders were constructed to make it easier for the migrating fish. They no longer have to jump over each of the weirs, they can swim through the holes. The fish ladders now also feature underwater windows where migrating fish can be viewed.

There are four fish ladders at Bonneville Dam. One allows fish to migrate past the first powerhouse and joins one that attracts fish from the south side of the spillway. That set goes past the Visitor Center on the Oregon shore where the underwater windows allow viewing on the first floor. Another allows fish to migrate past the second powerhouse and joins one that attracts fish from the north side of the spillway. This set goes past the Fish Viewing Building on the Washington shore where the underwater windows allow viewing.

Fingerling Bypass

There are three major ways that the Army Corps of Engineers attempts to get juvenile fish migrating to the ocean, past dams safely.

Water Budget

Water is allocated in the spring to help the smolt on their way to the ocean. Generally, smolt bodies have adapted to migrating to the ocean in close to 30 days. Reservoirs slow their migration which can effect their survival rate.

Water that would normally be saved for use at low water times is passed by dams to increase the flow between reservoirs and speed juvenile fish migration. The water budget is used to bring the flow of the river up to a certain minimum. It can all be passed through the turbines if the resulting power is marketable.

Submerged Traveling Screens

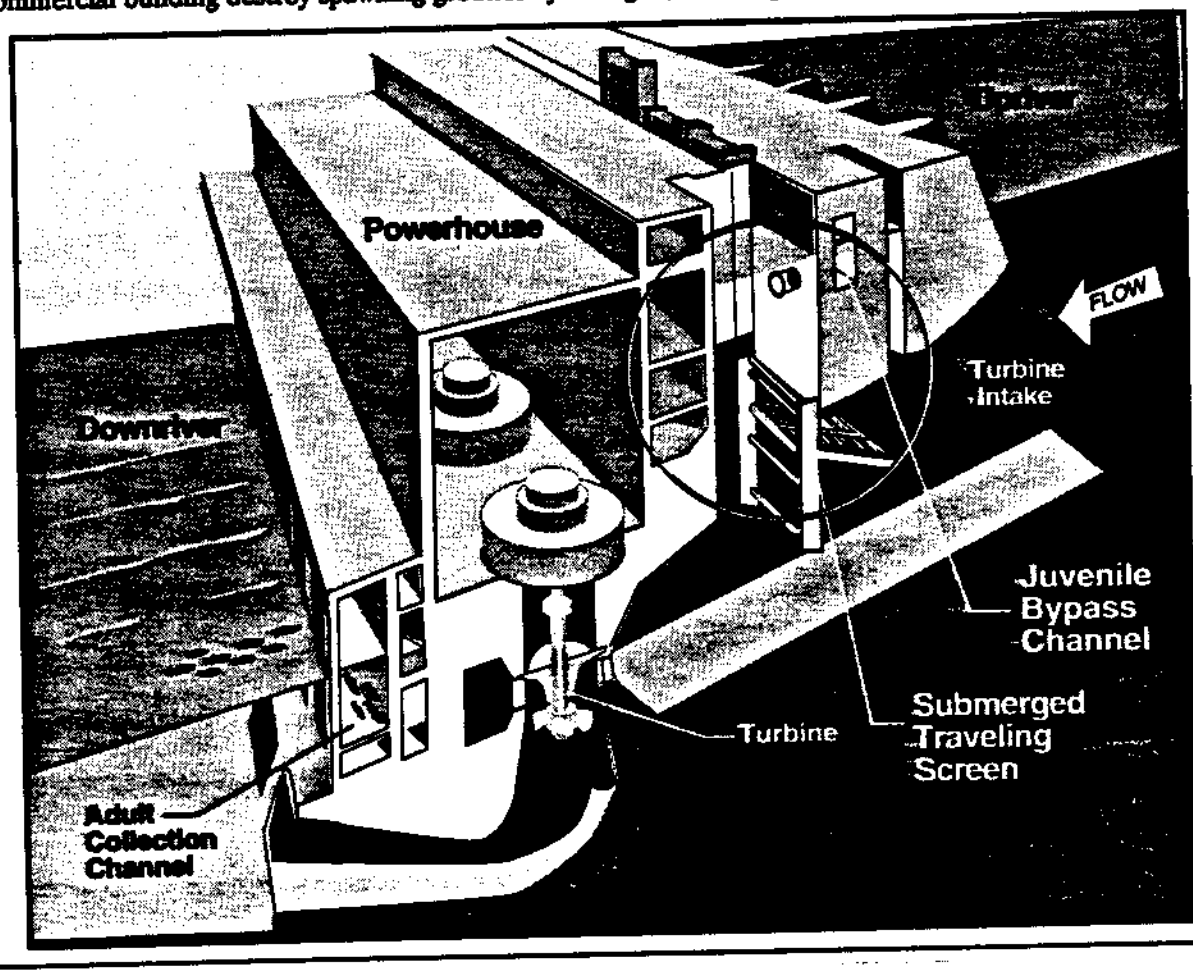
Engineers have designed what are known as **submerged traveling screens** that are placed near the roof of the **intakes** (where the water runs through the powerhouse). The screens guide some of the smolts out of the **turbine** intakes and into the juvenile bypass channel. The **juvenile bypass channel** is a channel that runs the length of the dam and leads the smolts to the **downriver** side of the dam.

Operation Fish Run and Juvenile Transport

The Army Corps of Engineers has developed a program of transporting smolts in trucks and barges from collection stations at upstream dams to below Bonneville Dam. This speeds the time it takes the smolts to make it to the sea and avoids the dangers of the dams and lakes.

Hatcheries

The Army Corps of Engineers also helps fund many fish hatcheries. **Fish hatcheries** supplement the fish that **wild runs** produce by mitigating for lost spawning ground. Many things have reduced the amount of **spawning** ground available to the salmon. Access to nearly half of the once available spawning ground was blocked by Chief Joseph dam on the Columbia and Hells Canyon dam on the Snake River. Other factors such as badly engineered logging and road construction, grazing cattle too close to the banks of a stream, pollution, and residential or commercial building destroy spawning grounds by silting in, warming or covering the stream.



Natural Resource Management
Before Your Visit

The following fish and natural resource-related activities may be used to prepare your students for a visit to Bonneville Dam.

Activities

Salmon In The News:

Salmon are often in the news. Beginning a few weeks before your visit, ask your students to bring in articles about salmon and other anadromous species. Students who are aware of current events often seem to get more out of their visit to Bonneville Dam. Use a bulletin board in the class for posting the articles. Discuss each article.

Salmon Life Cycle:

Ask your students to draw a representation of the life cycle of a salmon. The drawing may include: eggs, hatchlings, fingerlings, and adults.

Fish Migration Game:

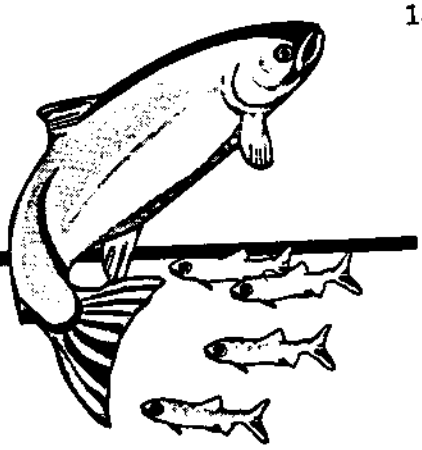
This game can be played either at Bonneville Dam or at the school in an outdoor or large indoor area. It will help students understand the lifecycle of anadromous fish, survival of the fittest and how this supports the food web.

The Anadromous Fish Game:

By playing the enclosed "ANADROMOUS FISH GAME," your students will become familiar with the life cycle of anadromous fish and they will learn how these fish get past Bonneville Dam.

Natural Resource Identification:

This game will help students to identify what resources are useful to us. Some natural resources are taken for granted because they are so familiar.



Fish Migration Game

Special Requirement!

Because this game involves large amounts of movement, ample space is needed. Play either indoors or outdoors.

This is a three-part activity (with a pre-game discussion, the game and post-game discussion) designed to acquaint participants with some of the difficulties encountered by anadromous fish; survival of the fittest; during the migratory phases of their lives and show how the anadromous fish life cycle supports the food web.

In nature, survival of the fittest is an important element in the survival of a species as a whole.

The Pre-game Discussion:

Bring the children together and ask them, "What problems do salmon face as they come up the river?" (Students should be somewhat familiar with the life cycle of salmon or other anadromous fish.) Problems could include anglers, predators, and migrating past dams, etc. Make a similar list of problems affecting juveniles migrating downstream. Predatory birds and fish, passing through turbines at powerhouses and any other problems that the students can think of. This discussion sets the number of variables for the game. Every problem mentioned becomes one of the active roles taken by those who volunteer to play the parts. Each person, or group of people will thus be identified as either young salmon, a dam, predatory fish or birds, anglers, etc.

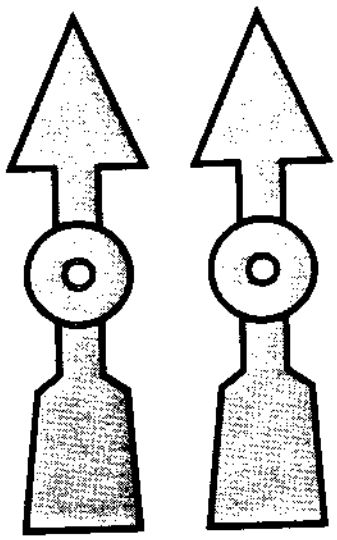
The Game:

Designate a pathway (about 50–100 feet long) as the stream or river. It should lead from the "spawning area" to the "ocean." Problems (children) should be placed along the pathway in their natural sequence (predators, anglers, etc.). The rest of the children are the migrating fish.

The young fish should follow the path to the ocean. As they travel, they should try to avoid being caught. A catch requires a touch on the shoulder. If caught, they should sit out the rest of the game and watch what happens. When the surviving young salmon reach the ocean, stop the game, talk about the loss of the juvenile fish and how they support the food web. Also talk about their years in the ocean where predators and ocean trawlers will take their toll and then let the survivors, who are now "adult" salmon, return to the spawning stream. Again, they should travel and avoid problems. At the end of the game their should only be one to two percent of the fish left.

The Anadromous Fish Game

Here's a board game with all the parts and direction provided. Just put it together and have fun!

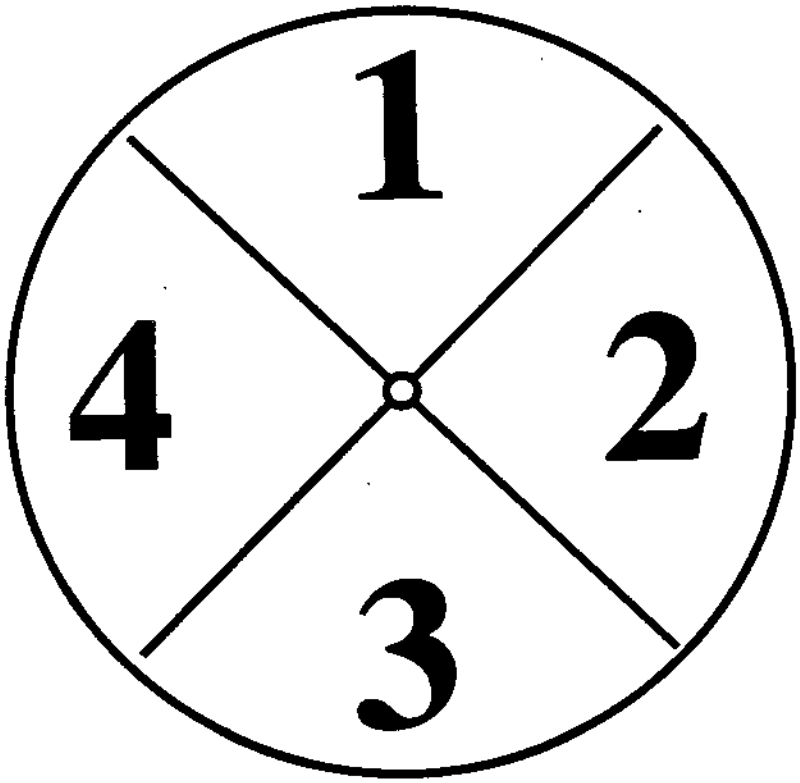


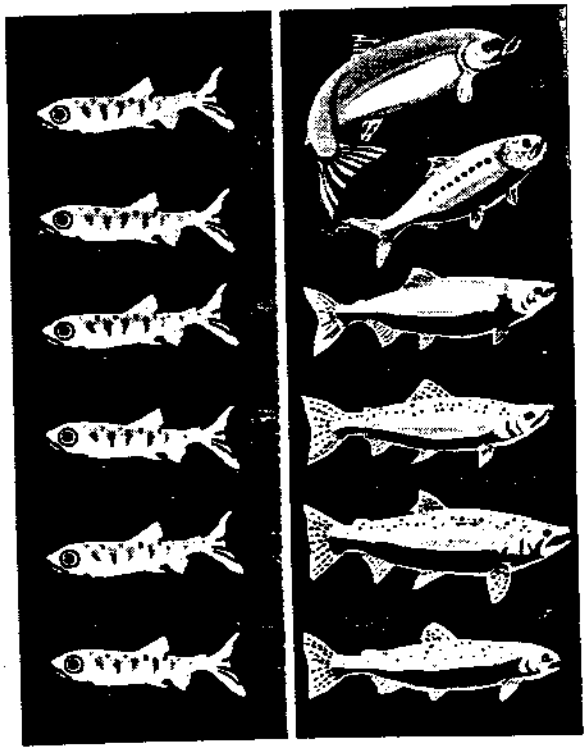
Directions:

1. Color the game board, arrow, fish, and spinner.
2. Cut them out with scissors.
3. Paste them to cardboard.
4. Attach the arrow to the spinner by piercing the center of both with a pin.

TO PLAY: Each player should spin the spinner once. The highest number goes first, then play in a clockwise direction. Everyone should start in the space marked start. This space is connected to the spawning stream and the hatchery which are two places where salmon are born.

The winner is the first player to move a salmon to the "ocean" and back to either the "spawning stream" or the "hatchery." Good luck!



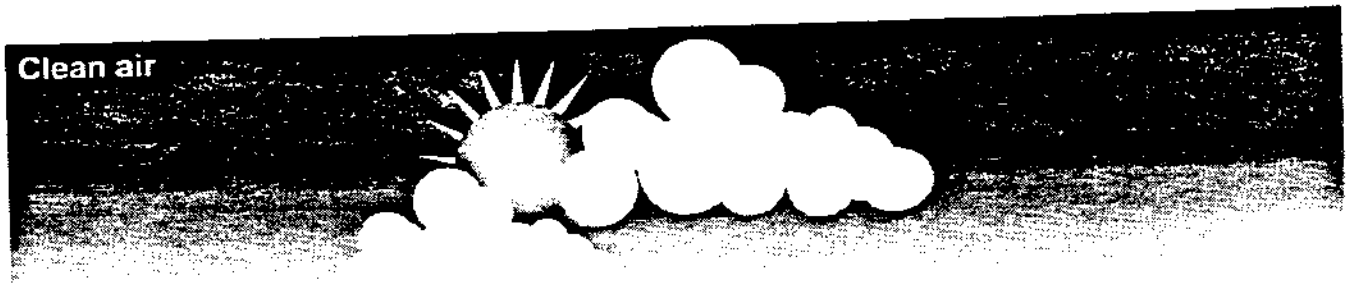


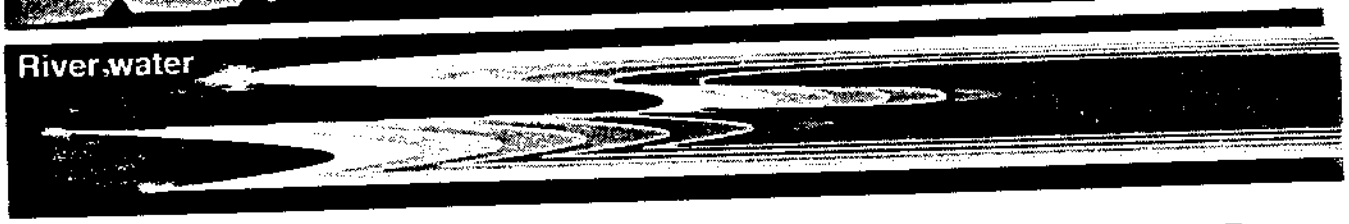
Natural Resource Identification

Natural resources are things in nature and may be useful to us in some way.

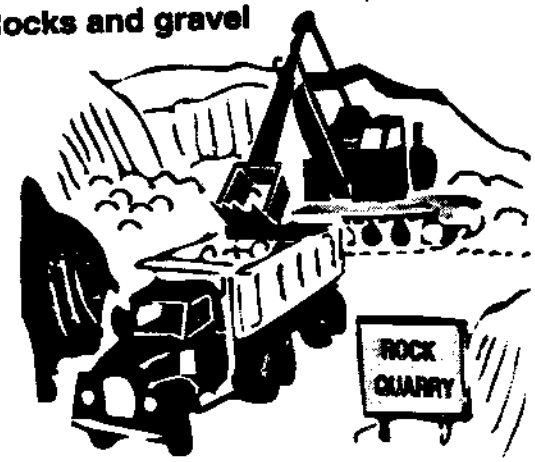
Below, you will see drawings of some of the natural resources that the Corps of Engineers takes care of at Bonneville Dam. Under each drawing, write how each of the living or non-living natural resources may be useful to people.

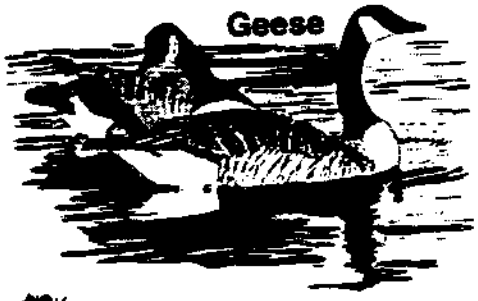
Next, draw lines between any of these natural resources which are connected somehow to one another. For example, geese need water so draw a line from the geese to the water. What other connections are there?





Rocks and gravel





Natural Resource Management During Your Visit

The purpose of this section is to give your students a self-taught learning experience while they are at Bonneville Dam. It includes self-guided tours of the facilities.

Most of the following activities are intended for a specific location. For many, the students will need copies of the activities and pencils.

Activities

On Your Way To The Dam:

Visit other dams and/or fish hatcheries. Stop at some of the many park and recreation lands in the Columbia Gorge to enjoy this spectacular natural area.

Bradford Island Visitor Center:

At the Bradford Island Visitor Center you will be able to view the fish ladder from both above and below water level. Exhibits on the lower floor will inform you about fish passage and life cycles. See the activity entitled, "A Self-Guided Tour of The Fish Ladder at the Bradford Island Visitor Center."

The Second Powerhouse Visitor Complex:

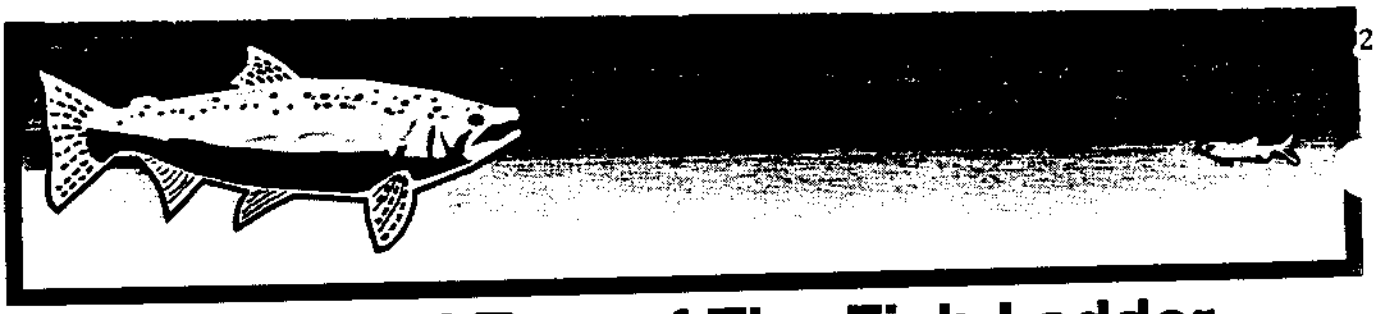
Facilities at the Second Powerhouse include fish ladder viewing from above and below water level, an exhibit about the history of fishing in the Gorge and exhibits about other aspects of fish migration and life cycles. See the activity entitled, "A Self-Guided Tour of the Fish Ladder at the Visitor Orientation Building."

The Bonneville Hatchery:

Highlights of the fish hatchery include rearing ponds, in which salmon are raised, sturgeon and trout ponds, where these fish are exhibited and a building where you can learn how salmon are processed.

Charting Resources And Animal Checklist:

A copy of this game should be given to each of your students. It will help them identify the natural resources at Bonneville Dam and what we have done to use or change the resource. After your visit you can discuss the importance of the resources the students have observed.



A Self–guided Tour of The Fish Ladder Bradford Island Visitor Center, Oregon

Use this sheet to find out how salmon get past Bonneville Dam.

Stop #1: Go To The First Floor Of The Visitor Center

Walk out the door to the right as you face the windows. Walk up the ramp. You will be outside looking at the fish ladders. Walk up them (south) and see if you can pick out each different section.

Walk down the steps to the first floor windows again. The windows you are looking through give you a view into the fish ladder.

Which way are the adult fish going in the ladder?

- ☐ a. with the current
- ☐ b. against the current

Is the fish ladder used mostly by adult fish or juvenile fish?_____

Stop #2: Look At The Models Of The Fish.

Name five kinds of fish seen in the ladder here at Bonneville Dam. Use the models to help you identify the fish you see in the ladder.

1._____ 2._____

3._____ 4._____

5._____

Where are the adult fish in the fish ladder going after they are out of the ladders?

- ☐ a. upriver
- ☐ b. downriver

Why do they have to get past Bonneville Dam?_____

True or False? At Bonneville Dam, fish are counted as they come up the ladder._____

Stop #3: Look At The Fish Count.

Which fish are counted?

1._____ 2._____

3._____ 4._____

5._____ 6._____

7._____

Why are the fish counted? _____

Stop #4: Look At The Migratory Patterns Exhibit.

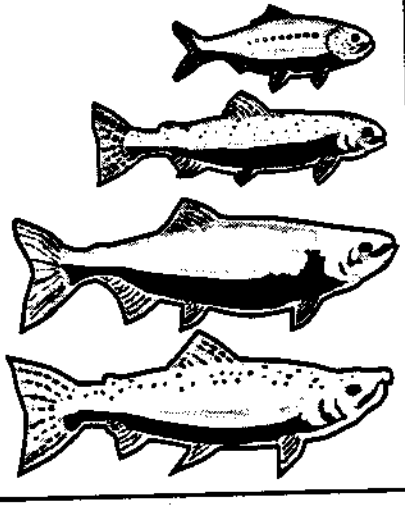
Columbia River Chinook spend _____or _____years at sea.

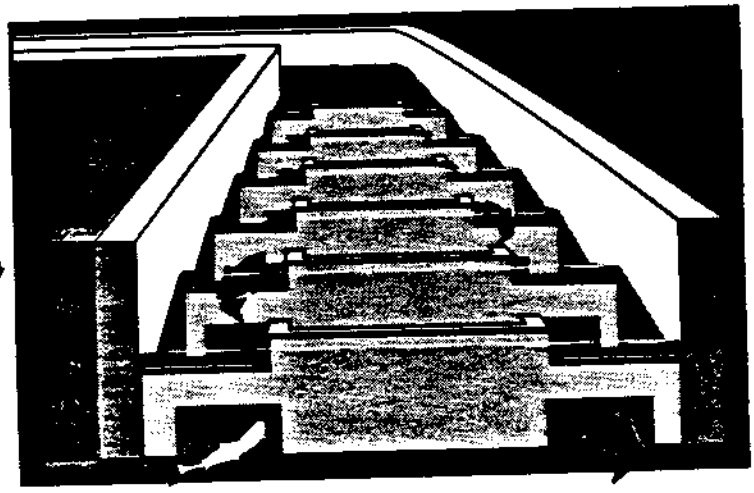
Bonus Question

As you have discovered, the ladders are mostly used by the adult fish going upstream to spawn. The fish going downstream go past the dam in several ways. Can you name two ways, other than the ladders, juvenile fish going downstream get past the dam.

1._____ 2._____

If you have questions about the fish or fish ladders, please ask at the information desk on the fourth floor.





A Self–guided Tour of The Fish Ladder Bradford Island Visitor Center, Oregon

Answers:

Use this sheet to find out how salmon get past Bonneville Dam.

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Walk down the steps to the first floor windows again. The windows you are looking through give you a view into the fish ladder.

Which way are the adult fish going in the ladder?

✓ **b. against the current**

Is the fish ladder used mostly by adult fish or juvenile fish? **adult fish**

Stop #2: Look At The Models Of The Fish.

Name five kinds of fish seen in the ladder here at Bonneville Dam. Use the models to help you identify the fish you see in the ladder.

1. **chinook salmon**
2. **coho salmon**
3. **shad**
4. **steelhead trout**
5. **sockeye salmon**

Where are the adult fish in the fish ladder going after they are out of the ladders?

✓ **a. upriver**

Why do they have to get past Bonneville Dam? **Salmon spawn in the same place they were reared which could be hundreds of miles past Bonneville Dam.**

True or False? At Bonneville Dam, fish are counted as they come up the ladder. **True**

Stop #3:Look At The Fish Count.

Which fish are counted?

1. chinook 2. coho

3. steelhead 4. chinook jack

5. shad 6. sockeye

7. coho jack

Why are the fish counted? The fish count helps set regulations, guide hatchery production and assists research.

Stop #4: Look At The Migratory Patterns Exhibit.

Columbia River Chinook spend one or six years at sea.

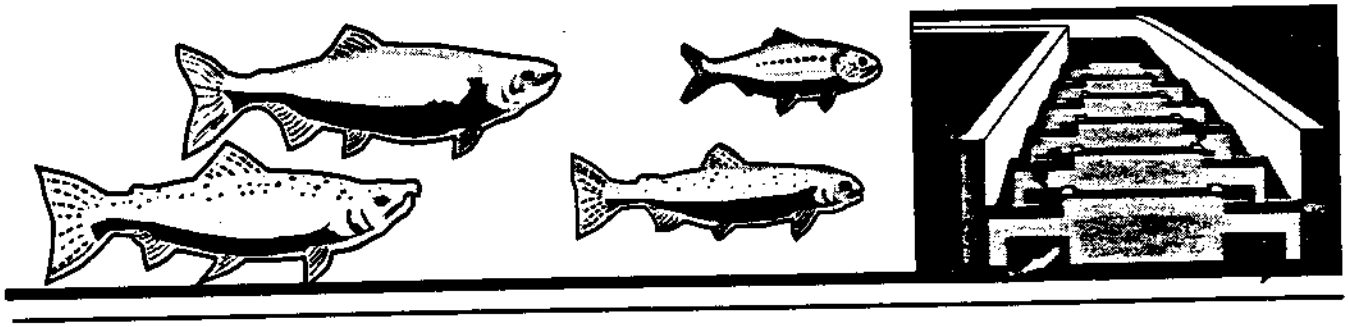
Bonus Question

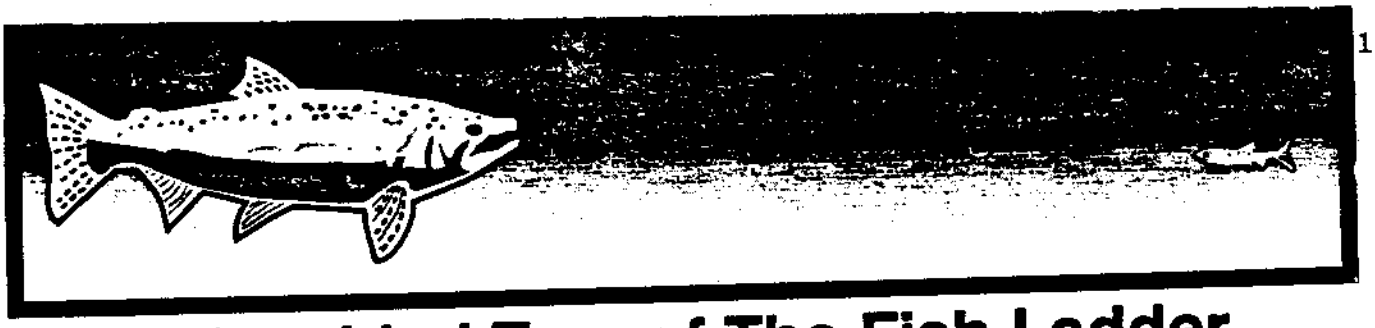
As you have discovered, the ladders are mostly used by the adult fish going upstream to spawn. The fish going downstream go past the dam in several ways. Can you name two ways, other than the ladders, juvenile fish going downstream get past the dam.

1. Many go over the spillway which is opened in the spring.

2. The fingerlings are collected at dams and hatcheries upriver then trucked and barged downriver to be released into the river just below Bonneville Dam.

If you have questions about the fish or fish ladders, please ask at the information desk on the fourth floor.





A Self-guided Tour of The Fish Ladder Visitor Orientation Building, Washington

Use this as a guide to the fish ladder at the second powerhouse.

Stop #1: Go down the escalator in the Visitor Orientation Building to the Fish Ladder. Walk along the fish ladders and see if you can pick out the different sections.

Stop #2: Go To The Fish Viewing Building.

Go down to the lower floor of the Fish Viewing Building. The windows you are looking through give you a view into the fish ladder.

Which way are the fish moving in the ladder?

- ☐ a. against the current
- ☐ b. with the current

Where are the fish in the ladder going after they pass the dam?

- ☐ a. upriver
- ☐ b. downriver

Is the fish ladder used mostly by adult fish or juvenile fish?_____

Why do the fish in the ladder have to get past Bonneville Dam?_____

Stop #3: Look At The Fish Count.

Which fish are counted?

1._____ 2._____

3._____ 4._____

5._____ 6._____

7._____

Why are the fish counted?_____

_____

Stop #4: Look At The Migratory Patterns Exhibit.

Columbia River Chinook spend_____ or_____ years at sea.

Stop #5: Look At The Models Of The Fish.

Name five kinds of fish seen in the ladder.

1._____ 2._____
3._____ 4._____
5._____

Use the models of the fish to help you identify the fish.

Stop #6: Go Upstairs To The Exhibit About Early Fishing.

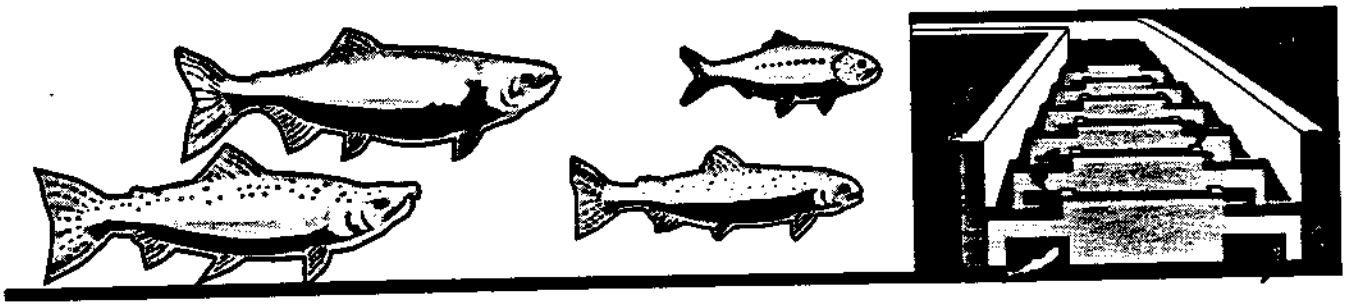
Who were the first people to fish in the Columbia River?_____

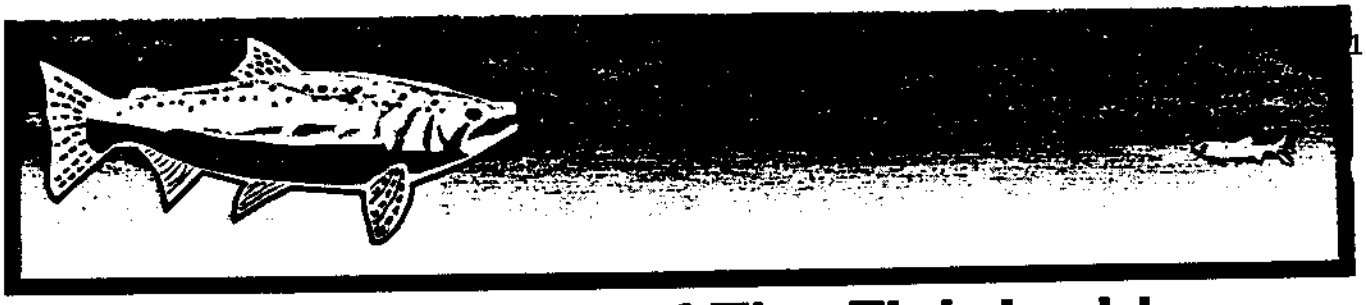
Bonus Question

The fish ladders are used mostly by the adult fish going upstream to spawn. Can you name two ways, other than the ladders, juvenile fish can get downstream past the dam?

1._____ 2._____

If you have questions about fish or fish ladders, please ask at the information desk.





A Self-guided Tour of The Fish Ladder Visitor Orientation Building, Washington

Answers:

Use this as a guide to the fish ladder at the second powerhouse.

Stop #1: Go down the escalator in the Visitor Orientation Building to the Fish Ladder. Walk along the fish ladders and see if you can pick out the different sections.

Stop #2: Go To The Fish Viewing Building.

Go down to the lower floor of the Fish Viewing Building. The windows you are looking through give you a view into the fish ladder.

Which way are the adult fish going in the ladder?

✓ **b. against the current**

Where are the fish in the ladder going after they pass the dam?

✓ **a. upriver**

Is the fish ladder used mostly by adult fish or juvenile fish? **adult fish**

Why do the fish in the ladder have to get past Bonneville Dam? **They spawn in the same place they were reared which could be hundreds of miles past Bonneville Dam.**

Stop #3: Look At The Fish Count.

Which fish are counted?

1. **chinook** 2. **coho**
3. **steelhead** 4. **chinook jack**
5. **shad** 6. **sockeye**
7. **coho jack**

Why are the fish counted? **The fish count helps set regulations, guide hatchery production and assists research.**

Stop #4: Look At The Migratory Patterns Exhibit.

Columbia River Chinook spend **one** or **six** years at sea.

Stop #5: Look At The Models Of The Fish.

Name five kinds of fish seen in the ladder.

1. **chinook salmon**
2. **coho salmon**
3. **shad**
4. **steelhead trout**
5. **sockeye salmon**

Use the models of the fish to help you identify the fish.

Stop #6: Go Upstairs To The Exhibit About Early Fishing.

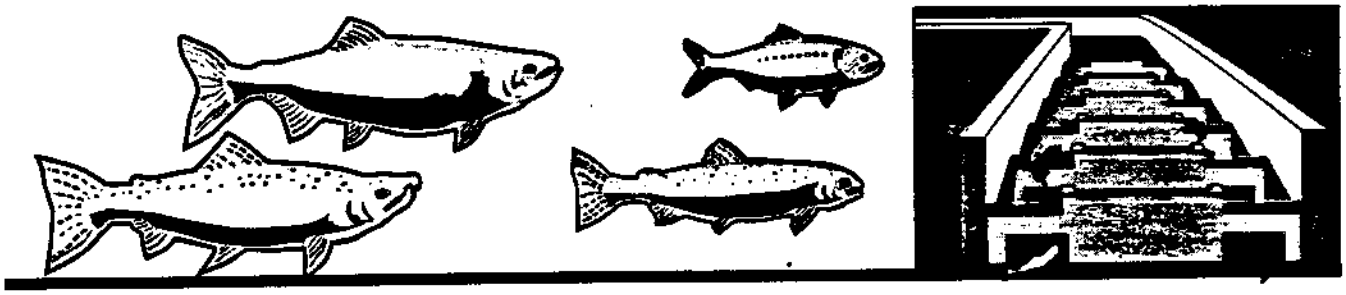
Who were the first people to fish in the Columbia River? **Native Americans**

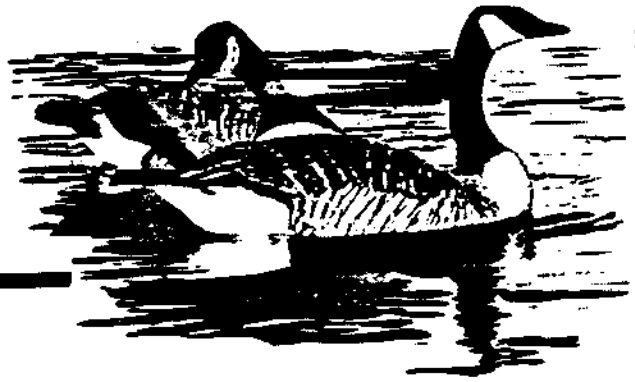
Bonus Question

The fish ladders are used mostly by the adult fish going upstream to spawn. Can you name two ways, other than the ladders, juvenile fish can get downstream past the dam?

1. **Many go over the spillway which is opened in the spring.**
2. **The fingerlings are collected at dams and hatcheries upriver then trucked and barged downriver to be released into the river just below Bonneville Dam.**

If you have questions about fish or fish ladders, please ask at the information desk.





Charting Resources

The Corps of Engineers has the job of managing, or taking care of, some of the natural resources found at the dam. While you are at Bonneville Dam, use this page to make a list of the natural resources you see.

Fill In The Chart Below:

Name Of The Natural Resource	What Have People Done To It?	What Can We Do To Take Care Of It?
Example: GEESE	When the dam was built and the water rose behind it, some nesting sites were flooded but other nesting sites were formed.	During nesting season we can control the water level in the river to make sure that nesting sites are not flooded.

Animal Checklist:

Animals are important natural resources. The animals listed below are often seen at or near Bonneville Dam. Put a check by each of the animals you see during your visit and write a description of what it looks like.

_____osprey _____

_____ gull _____

_____ Canada goose _____

_____ deer _____

_____ elk _____

_____ coyote _____

_____ beaver _____

_____ squirrel _____

_____ mink _____

_____ other _____

_____ other _____

Natural Resource Management
After Your Visit

The following activities are suggested for after your visit to Bonneville Dam. These are intended to reinforce what has been learned before and during your visit.

Activities

Make A Fish Mobile:

Use drawings of salmon, cardboard to reinforce them, and some sticks and string to make a hanging fish mobile. This will be a good reminder of your visit to Bonneville Dam. Sporting magazines could be a source of pictures.

Fishing For Facts:

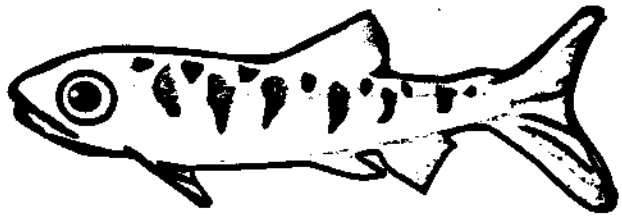
Quiz your students with the enclosed sheet labeled, "Fishing for Facts."

Managing A Resource:

This is a role playing activity designed to highlight the difficult decisions that must be made to manage a natural resource and the trade-offs that occur.

Fill In The Blanks Naturally:

This fill-in-the-blank activity will help students define "natural resource."



Fishing For Facts

Match the following by writing the number of the word in front of the correct definition.

Fishy Words		Fishy Definitions
1) Anadromous	_____	A place where people raise fish
2) Corps Of Engineers	_____	A passageway around a dam for adult fish going upstream
3) Fish Bypass Channel	_____	A fish that is born in a river, migrates to the ocean, then returns to the river to spawn
4) Operation Fish Run	_____	A passageway for fish migrating downstream past a dam
5) Fish Counter	_____	Young salmon are brought past dams in barges and trucks to increase their chances of survival
6) Fish Ladder	_____	the government agency which built and operates Bonneville Dam
7) Hatchery	_____	A word for salmon reproduction
8) Spawning	_____	A person who counts fish at Bonneville Dam

True Or False

Here are some true and false questions to answer:

Small, young salmon which are about as long as your finger are called fingerlings.

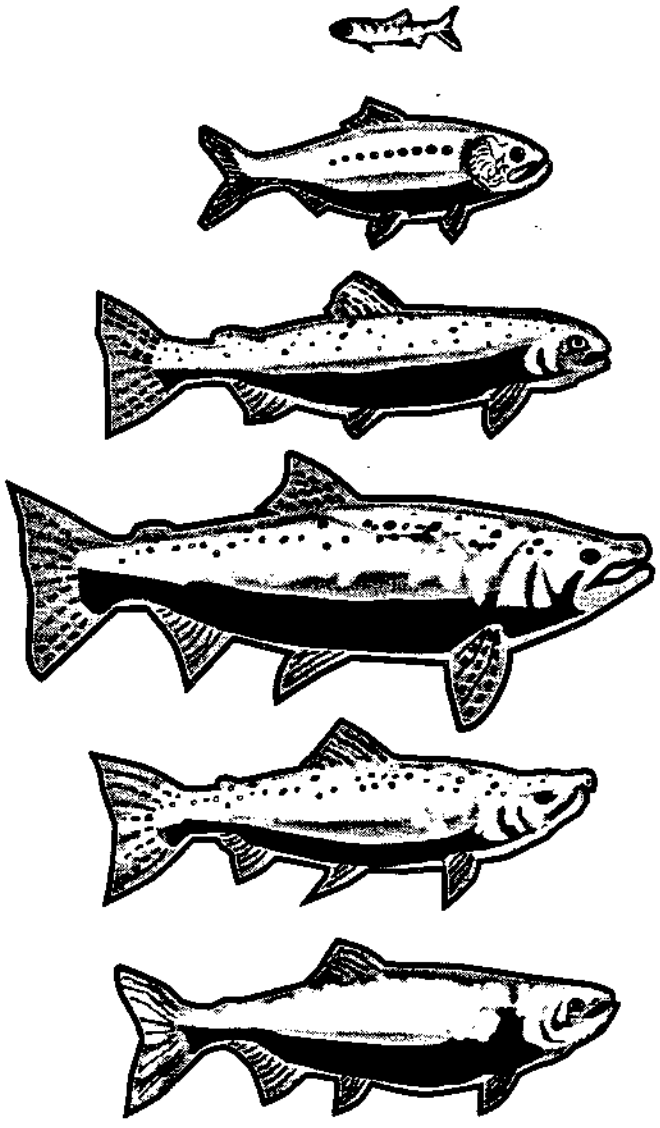
Adult salmon swimming in the river are usually going against the current.

Salmon spawn two or three times.

Smolts are young salmon which are migrating to the ocean.

Adult salmon eat a lot while swimming back up the river.

Salmon return to where they were hatched to reproduce (spawn).



Fishing For Facts

Answers: 7, 6, 1, 3, 4, 2, 8, 5

Match the following by writing the number of the word in front of the correct definition.

Fishy Words **Fishy Definitions**

7) **Hatchery** – A place where people raise fish

6) **Fish Ladder** – A passageway around a dam for adult fish going upstream

1) **Anadromous** – A fish that is born in a river, migrates to the ocean, then returns to the river to spawn

3) **Fish Bypass Channel** – A passageway for fish migrating downstream past a dam

4) **Operation Fish Run** – Young salmon are brought past dams in barges and trucks to increase their chances of survival

2) **Corps Of Engineers** – The government agency which built and operates Bonneville Dam

8) **Spawning** – A word for salmon reproduction

5) **Fish Counter** – A person who counts fish at Bonneville Dam

True Or False

Here are some true and false questions to answer:

Small, young salmon which are about as long as your finger are called fingerlings. **True**

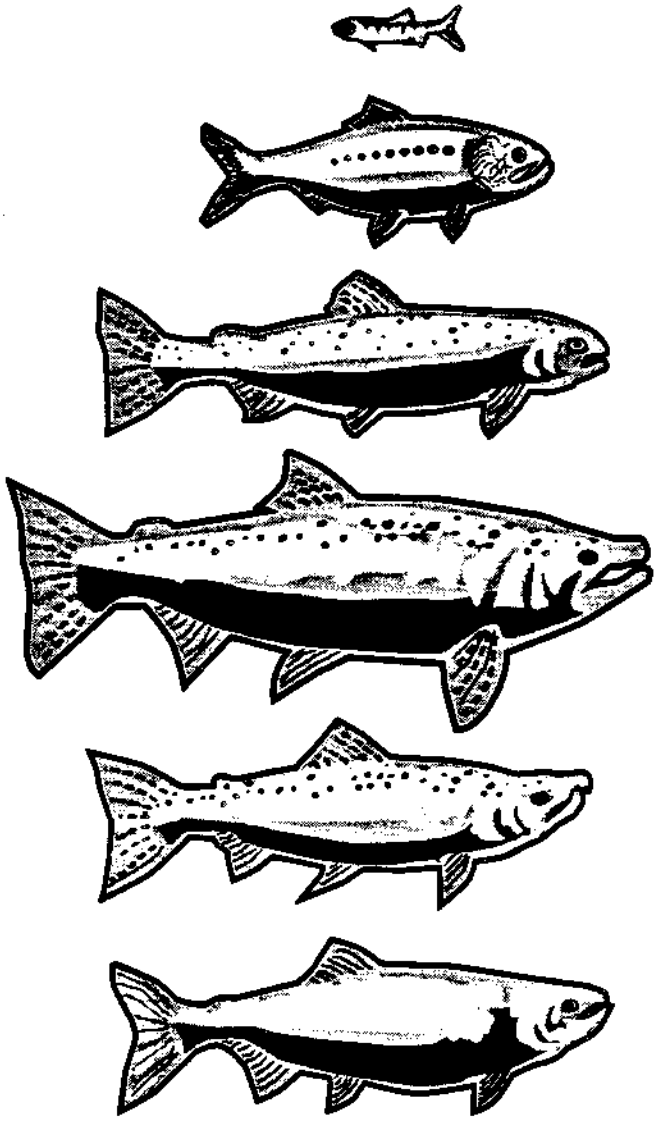
Adult salmon swimming in the river are usually going against the current. **True**

Salmon spawn two or three times. **False**

Smolts are young salmon which are migrating to the ocean. **True**

Adult salmon eat a lot while swimming back up the river. **False**

Salmon return to where they were hatched to reproduce (spawn). **True**



Managing A Resource

This role playing activity will help students understand some of the problems associated with managing a resource. Select a student or group of students to represent each of the following special interest groups. The issue to be discussed is the building of a new navigation lock at Bonneville Dam.

The "Actors":

Engineer – You want to build this lock to provide efficient and safe passage of commercial and pleasure craft. You want to make it the best and least expensive possible.

The Tug Boat Owner – You want a new lock that will be the same size as the others locks upstream from the dam. The present lock is much smaller. This will make it easier and less expensive for goods to go upriver.

Historian – An important historical structure, located near the lock may have to be torn down. This building houses a gym, theater, meeting rooms and is architecturally unique. You want to save it.

Wildlife Biologist – Construction of the new lock may destroy some nesting areas for geese. You want to save these or at least have some new areas made which geese can use for nesting.

Construction Worker – You want the lock to be built so you will have a job!

Resource Manager – You want to protect all of the natural resources at Bonneville Dam. You also will be running this meeting.

Logger – You want to buy the trees which will be cut down to make room for the construction of the lock.

Get these people together to discuss protecting resources while planning the construction of the lock. The group should discuss what can be done to protect resources like the river, geese, trees, and animals in the area. One good point to make is that it is sometimes possible to damage one resource while protecting another.

Another good point is that managing resources is only necessary when people change the natural situation for some reason.

Fill In The Blanks Naturally

If you worked as a park ranger or natural resource manager you would have to know about protecting and managing natural resources. To give you an idea of some of the things you will have to know about, fill in the blanks below.

1. Natural resources are things found in nature that may be useful to us in some way. List four examples of natural resources found at or near Bonneville Dam including:

   a. two living _____ _____
   b. two non–living _____ _____

2. Give an example of how two of the above are connected and interdependent.

   _____

3. List two ways that people have changed natural resources at or near Bonneville Dam.

   _____

4. How have these changes affected other natural resources?

   _____

5. Trade–offs are decisions we make to trade the benefits of some things to gain increased benefits from others. With this in mind:

   List one trade–off made at the dam._____

   For example: We trade a wild river for a series of reservoirs so that we can use water to meet a number of industrialized society's needs.

6. List one way the Corps of Engineers manages a resource.

   _____

7. List two ways you can help take care of natural resources.

   _____

8. List two jobs related to natural resources at a dam.

   _____

_____

Fill In The Blanks Naturally

Answers:

If you worked as a park ranger or natural resource manager you would have to know about protecting and managing natural resources. To give you an idea of some of the things you will have to know about, fill in the blanks below.

1. Natural resources are things found in nature that may be useful to us in some way. List four examples of natural resources found at or near Bonneville Dam including:

   a. two living **fish** **trees**
   b. two non-living **air** **water**

2. Give an example of how two of the above are connected and interdependent. **Fish need cool water; trees need water. Trees that grow next to water help cool the water for the fish that live in it.**

3. List two ways that people have changed natural resources at or near Bonneville Dam. **We have changed the river into a series of reservoirs. Most of the fish in the river are raised in hatcheries instead of the wild.**

4. How have these changes affected other natural resources? **Flooding has been reduced, habitat has improved for some fish and the reservoirs provide additional food sources for the birds of prey.**

5. Trade-offs are decisions we make to trade the benefits of some things to gain increased benefits from others. With this in mind:

   List one trade-off made at a hydropower dam. **We trade an abundance of wild salmon for hatchery salmon so we can have electricity and other benefits associated with dams.**

   For example: We trade a wild river for a series of reservoirs so that we can use the water to meet a number of industrialized society's needs.

6. List one way the Corps of Engineers manages a resource. **The Corps builds dams so that the water resource can be used to meet a variety of society's needs.**

7. List two ways you can help take care of natural resources. **conserve electricity, don't litter**

8. List two jobs related to natural resources at a dam. **park ranger, fish biologist**

Recreation
An Introduction

Visiting fish ladders, navigation locks, visitor centers and the fish hatchery are important recreational activities here at Bonneville Dam. Other recreational activities occurring around Bonneville Dam include fishing, boating, swimming, windsurfing and picnicking. Our goal is to make each visit and recreational activity a safe one. The purpose of this subject area is to inform your students about the recreational opportunities at Bonneville Dam and help them be safety conscious.

The first section includes activities for the classroom before your visit. Next, there are activities that can be conducted at Bonneville Dam. Finally there are activities included to reinforce what has been learned.

History Quickie

Fishing is and has been historically a major form of recreation on the Columbia River. The pioneers used to pull very large sturgeon out of the Columbia River with teams of horses. Now it is legal for sport or recreational anglers to take home only certain sized sturgeon. This is to protect the sturgeon so that future generations of people can also enjoy fishing sturgeon. Most sturgeon are ready to spawn only after growing to six or more feet in length.

Important Concepts

The activities in this section will help the students understand the following concepts. Important vocabulary words are in bold print.

The word **recreation** means the act of refreshing one's self. **The Army Corps of Engineers** has responded to public demand and provided recreation sites at Bonneville Dam and the surrounding area. You can fish, water-ski, camp, hike, windsurf and sight- see at or near Bonneville Dam.

The visitor center was built to provide people with a **recreation opportunity** and to help the public understand what the Army Corps of Engineers does. The visitor center provides the public with **interpretive services. Interpretation** is a way of teaching or informing the **public** while making the learning fun. At the visitor center you can learn about the history of the **Columbia River Gorge**, about how electricity is produced, or about the fish in the river.

Rangers are the people who take care of recreation sites. Their job is to answer any questions visitors might have, save a drowning person, give a visitor a citation for littering or they might be called to put out a fire or help a heart attack victim. Sometimes they just end up picking up litter or fixing things damaged by **vandalism.**

You as a visitor can help the rangers by practicing **safety and consideration.** When boating in the Columbia River remember to wear a **P.F.D.(personal flotation device).** They come in many varieties including: **life jackets, rings** or cushions. Use your **seatbelt** while in your vehicle. Remember to check the **fishing regulations** before going fishing. Always carry a **first aid kit** when out on an **excursion.** Remember to put litter in its' place. When you see someone violating the rules of safe and considerate conduct, please let a ranger know so a bad situation can be stopped before it becomes worse.

Why is recreation important? Why does it lead the participant to a sense of **fulfillment,** of improved mental and physical health? You might discuss this with your students and get their feelings on the subject. We hope when you come to Bonneville Dam you will have a good experience which will leave you and your students with an **appreciation** for the recreational opportunities and natural resources here. We hope this appreciation will help build a sense of **stewardship** toward all **natural resources.**

Recreation
Before Your Visit

The following activities will introduce your students to the recreation opportunities available at Bonneville Dam and along the Columbia River. The emphasis is on safety and learning to be considerate of other people who might be recreating at the same place and time or who might recreate there in the future.

Activities

Recreation Scramble:

This activity involves the students in unscrambling phrases related to recreation. The answers are on the page following the activity. You will want to make a copy of the sheet for each student.

Saving Sam:

One of the recreation opportunities available in the Columbia River is swimming. This activity will have the students think about how to be safe while swimming and what can be done in an emergency involving a drowning person. If your students are not familiar with first aid techniques emphasize knowing where a phone is to call for help, knowing what number to call, (such as 911), and finding a ranger if an accident occurs. Also, students should never jump in the water themselves to save someone drowning. It could mean two or more people drown instead of one. (The American Red Cross will teach first aid classes to children age 13 and above.)

Recreation Scramble

Recreation means to do something which provides relaxation and enjoyment. We want you to enjoy yourself when you come to Bonneville Dam. We also want you to have a safe visit.

Here are some enjoyable things you can do at Bonneville Dam. Circle your favorites!

See The Powerhouse

Look At The Fish Swimming In The Fish Ladder

See A Film

Look At A Boat Going Through The Lock

Visit The Big Sturgeon At The Fish Hatchery

Have A Picnic

Go Fishing

Here are some other things which some people do at Bonneville Dam. Unscramble the phrases and think about whether or not you would like to do that activity and the effects of your choice.

1 Wear A Life Jacket (P.F.D. Personal Flotation Device)
Or
orwdn fi rouy taob nikss

_____

2 Keep Your Dogs On A Leash
Or
etl oyru ogd nur onruda dan therbo lopepe nda milsana

_____

3 Wear Your Seatbelt In Your Car In Case Of An Accident
Or
etg jeinurd ni a rac cednatic

_____

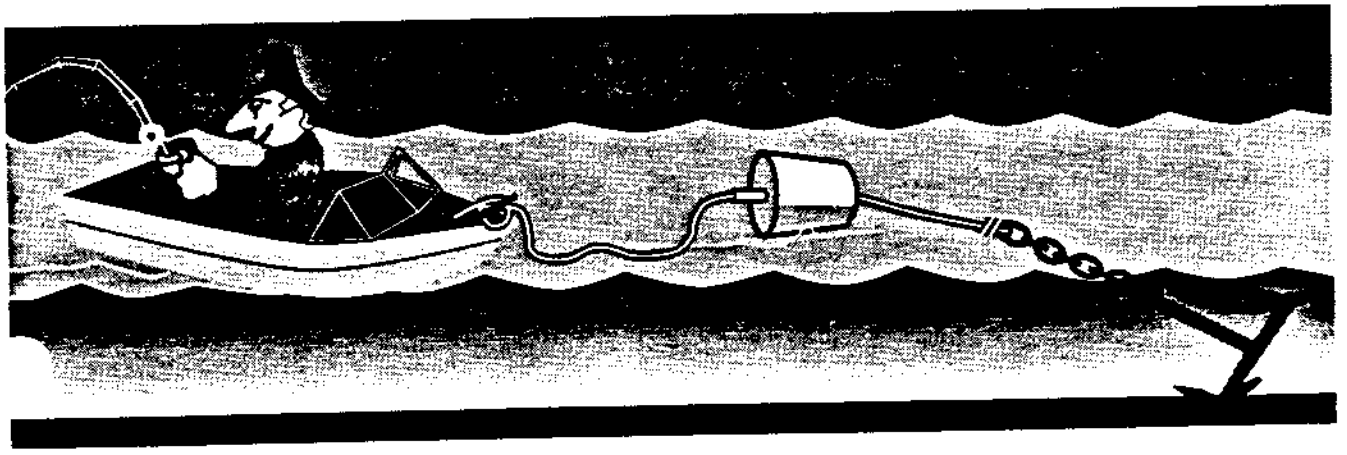
_____

4 Carry Your Litter To A Trash Can
Or
veha a cpinci ni a tidelret akrp

5 Keep The Volume Of Your Radio Low Enough So It Doesn't Bother Anyone Else
Or
veha ot sentil ot emsoneo lesse' ODUL sucim

6 Have A Restroom To Use When You Need One
Or
nfid a rerosotm sodlec acubsee fo dislamanv

7 Have Beautiful Old Trees To Have A Picnic Under
Or
yrosedt etres yb virganc uroy tilasini ni meht



Recreation Scramble

Answers:

Here's how the ends of the phrases unscrambled:

1 Wear A Life Jacket (P.F.D. Personal Flotation Device)
Or
drown if your boat sinks.

2 Keep Your Dogs On A Leash
Or
let your dog run around and bother people and animals.

3 Wear Your Seatbelt In Your Car In Case Of An Accident
Or
get injured in a car accident.

4 Carry Your Litter To A Trash Can
Or
have a picnic in a littered park.

5 Keep The Volume Of Your Radio Low Enough So It Doesn't Bother Anyone Else
Or
have to listen to someone else's LOUD music.

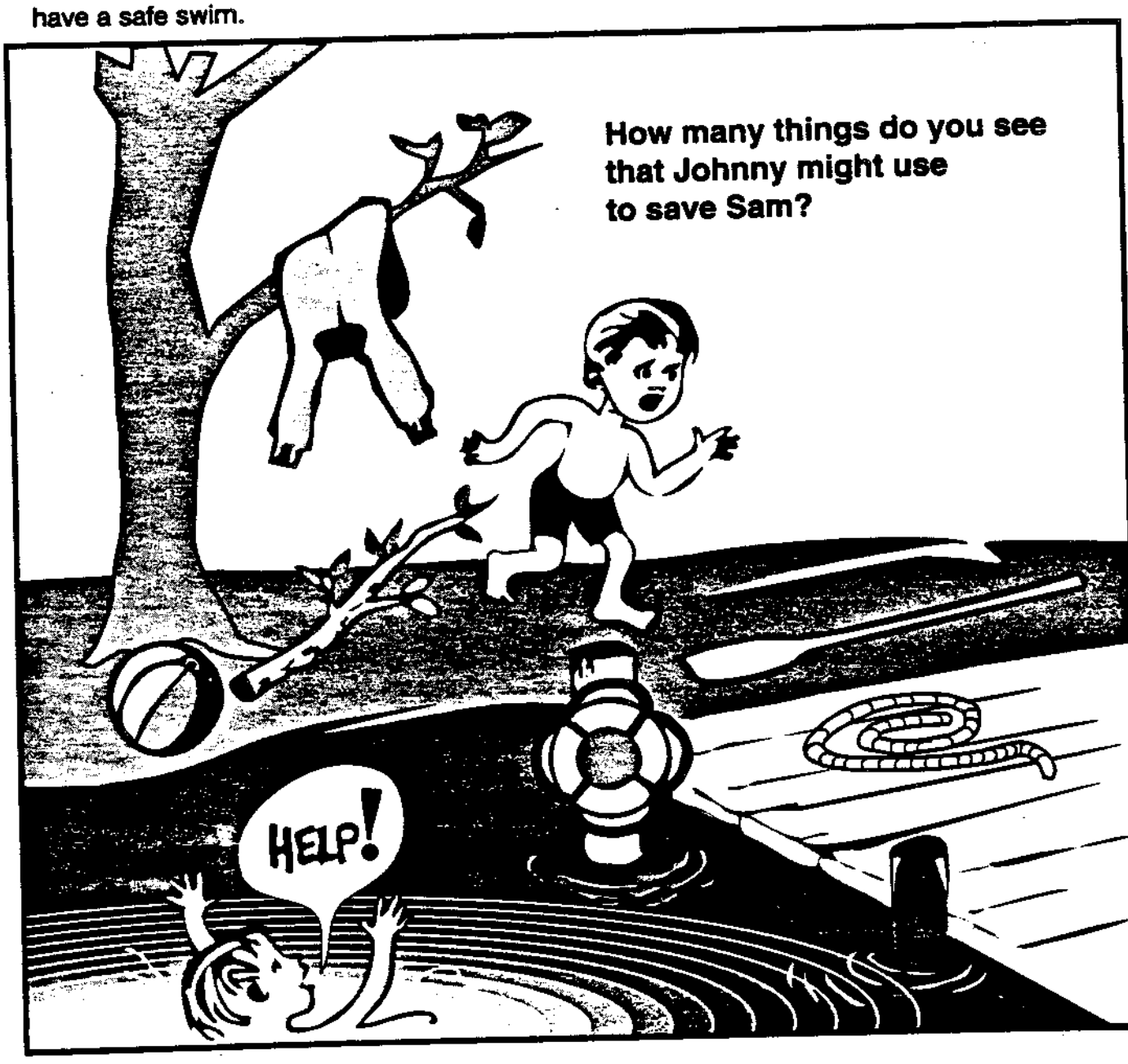
6 Have A Restroom To Use When You Need One
Or
find a restroom closed because of vandalism.

7 Have Beautiful Old Trees To Have A Picnic Under
Or
destroy trees by carving your initials in them.

SAVING SAM

How will you save Sam?

Write a story telling what you will use to save Sam and what you will do when you get him out of the water. Be sure to include in your story what things you have done to be sure you have a safe swim.



Recreation During Your Visit

The following activities will help your students record the great diversity of recreational activities available to them at Bonneville Dam and emphasize how to enjoy the recreation safely and considerately. While at Bonneville Dam, have your students practice these concepts.

Activities

On Your Way To The Dam:

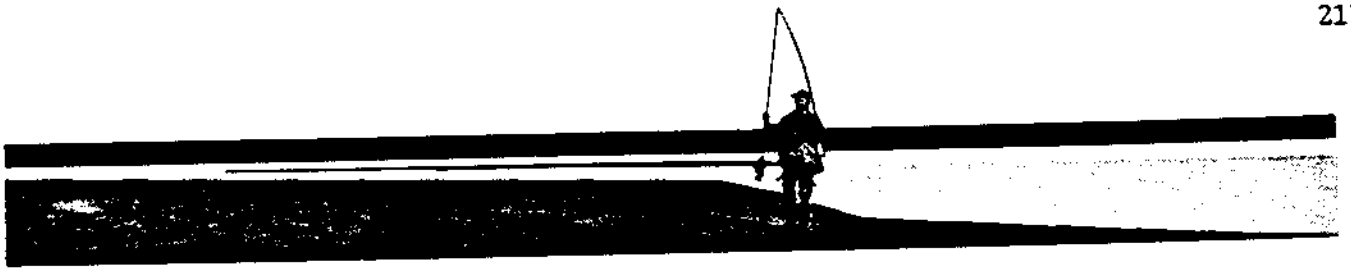
As you travel to the dam, some of your students can keep a list of all of the recreational activities they see. When you return to the classroom, you could lead a discussion of how building a dam on a river can change the type of recreational opportunities.

Have A Nice Time:

This activity will allow the students to record some of the recreational behavior they see while at Bonneville Dam. You might discuss the activities they see. What could have been done more safely or with more consideration for others and why. Why is recreation important? They will need pencils and a copy each of the activity.

Recreation In Pantomime:

This activity should be conducted in a large area. It will give the students a chance to act out correct and incorrect recreational behavior.



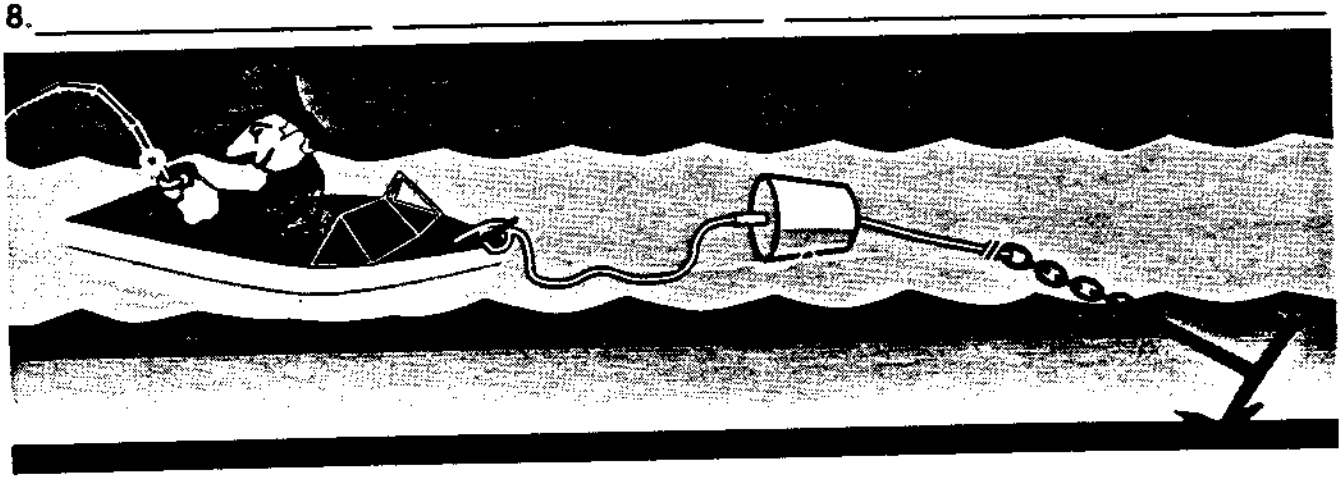
Have A Nice Time

Recreation means to do something that provides relaxation and enjoyment. We want you to have a good time at Bonneville Dam.

Make a list of all of the recreation possibilities at (or near) Bonneville Dam. Write these beside the numbers in the column labeled "recreation".

In the columns labeled "safety hazards?" and "safe solutions!", write any hazards and ways of avoiding these hazards. See how many you can find!!!

Recreation	Safety Hazards?	Safe Solutions!
1. fishing	hooking someone in the eye while casting your line	look behind you before casting
2.		
3.		
4.		
5.		
6.		
7.		
8.		



Recreation In Pantomime

This game requires a lot of space. Find a large grassy area to conduct this activity. It can be played with partners or teams. One or a couple of team members are designated the pantomimists. These people are given the situation to pantomime for the others. The others have to guess what the person is pantomiming. The first team to guess what is being pantomimed, gets a point. If they can tell everyone what an appropriate solution to the situation might be, they can gain another point. The team with the most points at the end of the game wins.

Pantomimists change each situation so that all the students get a chance to pantomime and guess.

Situations

A person getting into a car without putting on a seatbelt. They crash and are thrown headlong out the front window.

A person going water-skiing without a life jacket or P.F.D.

A person going boating without having first checked to be sure everything is in good working order.

A person going hiking without a water bottle and finding no water on the trail.

A person carving their name into a tree or picnic table.

A person with some unleashed dogs in a busy public area.

A person or people littering a swimming area and one stepping on a piece of broken glass.

A person or people going camping and realizing they have forgotten a flashlight.

A person riding a bike without wearing a helmet or having a first-aid kit in their backpack.

A person trying to get into a restroom and finding it has been locked due to vandalism.

Make up a few situations for the students to pantomime or have them make up some situations.

Recreation
After Your Visit

These activities will not only reinforce the recreation concepts learned previously, but will also give the students an idea of what the people who work to provide these recreational opportunities do.

Activities

Ask A Ranger:

Rangers are available to answer the public's questions. This activity has the students match the question with the correct answer.

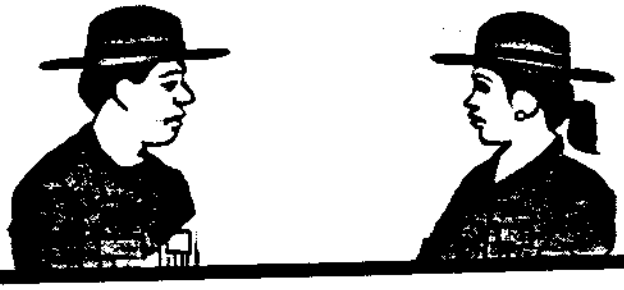
Hidden Ranger Words:

This word search activity will show what rangers do and how to identify rangers.

Ask A Ranger

This is your chance to pretend you are a ranger at a Corps of Engineers project. As a ranger, you will be asked many questions by people who come to recreate. Match the questions listed in the first column by writing the number of the question in front of the answers in the second column. There is only one answer for each question.

Recreation Questions	**Ranger's Responses**
1 What are some things rangers do here?	_____ One of the Corps many responsibilities is providing for safe recreation.
2 Why was a visitor center built at this dam?	_____ Another name for a life vest.
3 What is a personal flotation device (P.F.D.)?	_____ Keep your dog on a leash and keep your stereo turned down low
4 What are the most common accidents that occur here and how can we prevent them?	_____ Almost anywhere! Especially in the visitor center and fish hatchery.
5 How can I show consideration for others when I recreate?	_____ We answer questions and tell why the area is special.
6 What are two good ways to help this campground stay clean?	_____ Swimming, boating, hiking, wildlife watching, picnicking, and fishing!
7 Where can we have fun here?	_____ Pick up litter and clean up after your pets.
8 What are some of the things that we can do around here?	_____ We answer questions and help you in emergencies.
9 What is a park interpreter or a park guide?	_____ To tell the public what we are doing.
10 Why does the Corps of Engineers let us recreate here?	_____ Car accidents and boating accidents are serious problems. You can help by wearing your seatbelt and your P.F.D.



Ask A Ranger

Answers:

This is your chance to pretend you are a ranger at a Corps of Engineers project. As a ranger, you will be asked many questions by people who come to recreate. Match the questions listed in the first column by writing the number of the question in front of the answers in the second column. There is only one answer for each question.

Recreation Questions	Ranger's Responses
1 What are some things rangers do here?	__10__ One of the Corps many responsibilities is providing for safe recreation.
2 Why was a visitor center built at this dam?	__3__ Another name for a life vest.
3 What is a personal flotation device (P.F.D.)?	__5__ Keep your dog on a leash and keep your stereo turned down low
4 What are the most common accidents that occur here and how can we prevent them?	__7__ Almost anywhere! Especially in the visitor center and fish hatchery.
5 How can I show consideration for others when I recreate?	__9__ We answer questions and tell why the area is special.
6 What are two good ways to help this campground stay clean?	__8__ Swimming, boating, hiking, wildlife watching, picnicking, and fishing!
7 Where can we have fun here?	__6__ Pick up litter and clean up after your pets.
8 What are some of the things that we can do around here?	__1__ We answer questions and help you in emergencies.
9 What is a park interpreter or a park guide?	__2__ To tell the public what we are doing.
10 Why does the Corps of Engineers let us recreate here?	__4__ Car accidents and boating accidents are serious problems. You can help by wearing your seatbelt and your P.F.D.

Hidden Ranger Words

Here's a "word search" activity that tells you some of the activities rangers at Bonneville Dam do during the day. GOOD LUCK! If you find all the words, a secret message will be left behind.

E H C R E S C U E S M L I F
N A I E T H W I L D L I F E
V T L S A F E T Y P I L O T
I E B O A T R A F I S H R O
R N U U P A N G I E R E E U
O O P R A N G E R I S L S R
N I S C T K C A S T M P T E
M T H E R E A M T A R M Y C
E C O B O R R B A L O Y O R
N E W A L K S U I K F I R E
T T A D U T Y L D S N U R A
F O T G R I C A M P I N G T
S R E E N I G N E P A R K I
S P R O C E N C D R A D I O
I N T E R P R E T A T I O N

The **BOLD** words below are hidden in the puzzle above. See if you can find them. They can be found up, down or backwards, but not diagonally. Some letters are used more than once. The words that go together in the sentences below won't necessarily be found together in the puzzle. Once you have found the words, black them out. The remaining letters will spell out a special message.

This is all about the **ARMY CORPS** of **ENGINEERS PARK RANGERS**. You will see them around the project as they go about their duties. They are the ones in the uniform with the white shoulder patch, gold **BADGE**, flat **HAT**, and usually carrying a two–way **RADIO**.

One **DUTY** of theirs is to provide for the **PROTECTION** of the **ENVIRONMENT**. This includes the **FOREST** and the **WILDLIFE**, as well as the **WATER** and the **FISH**. Each of these is a natural **RESOURCE**. The rangers are also responsible for the **SAFETY** of the **PUBLIC**. This requires that they be able to operate the **FIRE** engine and a water **TANKER**, and to use a **PATROL CAR**. They must be able to **PILOT** a **RESCUE BOAT**, and be able to call an **AMBULANCE**. They must know how to give **FIRST AID** or any other kind of **HELP** necessary. This includes being able to **INFORM** the visitors of places to go **CAMPING**, boating or many other forms of **RECREATION**.

The rangers are also involved in **INTERPRETATION** of the project. They may be called upon to give **WALKS**, **TALKS**, and **SHOW FILMS**. They would be happy to arrange a special **TOUR** upon request. All in all, the rangers are kept busy, but they like it that way.

Hidden Ranger Words

Answers:

E	H	C	R	E	S	C	U	E	S	M	L	I	F	
N	A	I	E	T	H	W	I	L	D	L	I	F	E	
V	T	L	S	A	F	E	T	Y	P	I	L	O	T	
I	E	B	O	A	T	R	A	F	I	S	H	R	O	
R	N	U	U	P	A	N	G	I	E	R	E	E	U	
O	O	P	R	A	N	G	E	R	I	S	L	S	R	
N	I	S	C	T	K	C	A	S	T	M	P	T	E	
M	T	H	E	R	E	A	M	T	A	R	M	Y	C	
E	C	O	B	O	R	R	B	A	L	O	Y	O	R	
N	E	W	A	L	K	S	U	I	K	F	I	R	E	
T	T	A	D	U	T	Y	L	D	S	N	U	R	A	
F	O	T	G	R	I	C	A	M	P	I	N	G	T	
S	R	E	E	N	I	G	N	E	P	A	R	K	I	
S	P	R	O	C	E	N	C	D	R	A	D	I	O	
I	N	T	E	R	P	R	E	T	A	T	I	O	N	

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EXHIBIT VI

EXAMPLES OF OTHER ENVIRONMENTAL EDUCATION PROGRAMS PRESENTLY BEING CONDUCTED AT CORPS LAKES.

E C O - M E E T

What is an Eco-Meet?

An Eco-Meet is a one day program for students from elementary through high school grades sponsored by the U.S. Army Corps of Engineers, Pittsburgh District. It consists of a series of environmental competitions between participating school districts and is conducted at Corps Lakes.

Eco-Meets are designed to stimulate a greater awareness of the environment in school age children. Since its inception in 1976, it has provided an opportunity for schools to become acquainted with available resources at Corps sites for conducting their own environmental education programs.

The term "Eco-Meet" is a combination of "eco" and "meet". "Eco" is taken from Ecology, the Science which studies the interaction of organisms and their environment. The word "meet" was selected to give the feeling of an athletic event to the program.

Eco-Meets in the Pittsburgh District are presently held at 9 lakes in western Pennsylvania and eastern Ohio. Winners from these meets are invited to the district finals held at Crooked Creek Lake.

Corps Rangers conduct the competitions and act as judges and score-keepers. Corps Volunteers may also serve in this capacity.

Schools compete by bringing students from various grade levels which comprise a squad. A full squad consists of a minimum of three to a maximum of five students. Squads are grouped into the following divisions: Nature Sleuth Squad (grades 1-6); Junior Varsity Squad (grades 7-9); and Varsity Squad (grades 10-12). Squads must have a designated coach who must accompany the squad to the meet.

At the meet, squads compete in three 50 minute events. Each event is tailored for the appropriate age level. Events from 1992 were as follows: Nature Sleuth: Wildlife Ecology, Scavenger hunt, and a Discovery topic which changes each year (1992 was wildflowers). Junior Varsity: Reptile and Amphibian Ecology, Avian Ecology, and Eco-sketch. Varsity: Interpretation, Forest Communities, and Aquatic Ecology. At the conclusion of each event is a review period so that students can receive immediate feedback and learning from the process.

Individuals compete independently, except in the Nature Sleuth Scavenger Hunt, Junior Varsity ECO-Sketch and Varsity Interpretation. In the Scavenger Hunt, individuals may cooperate in their efforts to locate and find listed items. The ECO-Sketch is also an event where squad members attempt to guess the subject of a drawing. Interpretation is based on balanced group participation, among other criteria.

Once a competition has started, coaches or assistants may not instruct the squad or student, except between events. Coaches and assistants must attend a designated coaches event if one is conducted.

Over the past 17 years, Eco-Meets have served to expose and educate hundreds of students about the resources of Corps projects.

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING – P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF:

THE CORALVILLE LAKE INFORMATION AND RESOURCES PROJECT

The Coralville Lake Information and Resources Project (CLIRP), is a cooperative program effort between the U.S. Army Corps of Engineers at Coralville Lake and the Iowa City, Iowa school system.

Part of the 5th grade science curriculum of the Iowa City schools covers a unit on soil study. The project interpreter at Coralville Lake assists the science coordinators at the local schools by providing fall field trip programs at the project which cover information on water safety, forest succession and soil erosion and formation.

In-class pre trip activities in the way of student and teacher handbooks, slide programs and site orientation are provided by the interpreter. General guidelines and policies concerning the trip are discussed.

Groups arrive at 0930 hours and participate in the water safety and forest ecology programs before having lunch in one of our picnic shelters. After lunch, the soil; study begins. For soil formation, forces in nature which break down parent material (limestone rock) are discussed. Rocks are heated on a hot plate, then dunked in ice water by the interpreter to show how it breaks apart when exposed to the elements. Students get to rub pieces of limestone rock together to form crude soil. Students also view a cut bank and discuss and draw the different layers of soil, writing out the characteristics of each.

The soil erosion program is also a hands on study of how slope, vegetation and soil type effect erosion. Shallow pans are filled with clay soil (with vegetation and without vegetation) and sandy soil (also with vegetation and without vegetation). Students place the pans on wooden blocks which tilt the pans at varying angles and then pour water onto the soil. Run off is collected and observed. Each student then makes his or her own conclusions as to what soil type in what slope is most likely to erode. Conservation practices are discussed. Fun word games are also played.

TITLE: Adopt Lanier's Future

LOCATION: On over 100 islands on Lake Lanier ranging from one-half acre to 135 acres.

TIME/LENGTH/SEASON: Islands may be adopted for one-year periods so that participants may see how islands change during all four seasons. An option to renew the island adoption agreement is available. Activities may take place daily yearround but not after sunset. A cleanup must be scheduled at least four times a year.

OBJECTIVES:

1. Participants will serve as the "eyes and ears" for the Corps of Engineers' rangers and report any acts of vandalism, unsafe conditions, or environmental concerns on "their" island.

2. Participants will keep their island clean of trash and debris from visitors or wastes brought in by water.

3. Participants will monitor the island's ecosystem and at least one time during the year assistance will be provided by a wildlife specialist from the Univ. of Georgia.

4. Participants will know the role and mission of the Corps of Engineers in protection, preservation, and stewardship of the resource.

5. Participants will have fun and enjoy themselves with family and friends while obtaining an environmental awareness of the lake and protecting it for future generations.

INTENDED AUDIENCE:

-Individuals or families who have access to a boat.
-Participants must be at least 12 years of age. If under age of 18, they must have written parental consent.
-Civic clubs or organizations.

FEES/COSTS INCURRED: Free to all participants. Costs to the Corps of Engineers includes: time involved in phone calls to participants, calligraphy for certificates ($7.00 ea.) upon completion of adoption, plaques for groups upon completion of adoption program ($25.00 ea.). Unique patches are needed for the program. Estimated cost per patch is $1.25.

SUPPLIES AND MATERIALS:

Required by participants: Boat (and all Coast Guard approved requirements for boat operation including appropriate personal floatation devices for all on board), first aid kit, workboots, gloves, longsleeved shirt, work pants(jeans), camera to take photos of work in progress.

Required by COE: Plaques to organization or certificates to individuals completing project. Patches to participants. Registration packet.

Helpful: Bird, tree, wildflower guidebooks, binoculars, paper/pen to write down observations.

RESEARCH AND KEY REFERENCE MATERIALS:

Lakeshore Management Plan, general interpretive books on lakes/pond life available at local library.

ALTERNATIVES:

Cancel for unsafe weather conditions.

MISCELLANEOUS/PECULIARITIES: Participants must keep track of all volunteer hours. Safety meetings among groups required before trips to islands.

AREAS OF CONCERN:

-Safety for participants (ie. disposing of unsafe trash items without wearing personal protective clothing/gloves/boots).
-All hazardous materials discovered must be reported to the Corps of Engineers for removal.
-Wells from old homesteads must be reported to the Corps immediately for removal.
-All trips to the island for volunteer work must be reported to the volunteer coordinator at least two days before the trip takes place and following the trip in order for participants to be covered by Workman's Compensation and to notify maintenance of extra trash taken to boat ramps.
-No alcoholic beverages allowed.

PROGRAM HISTORY:

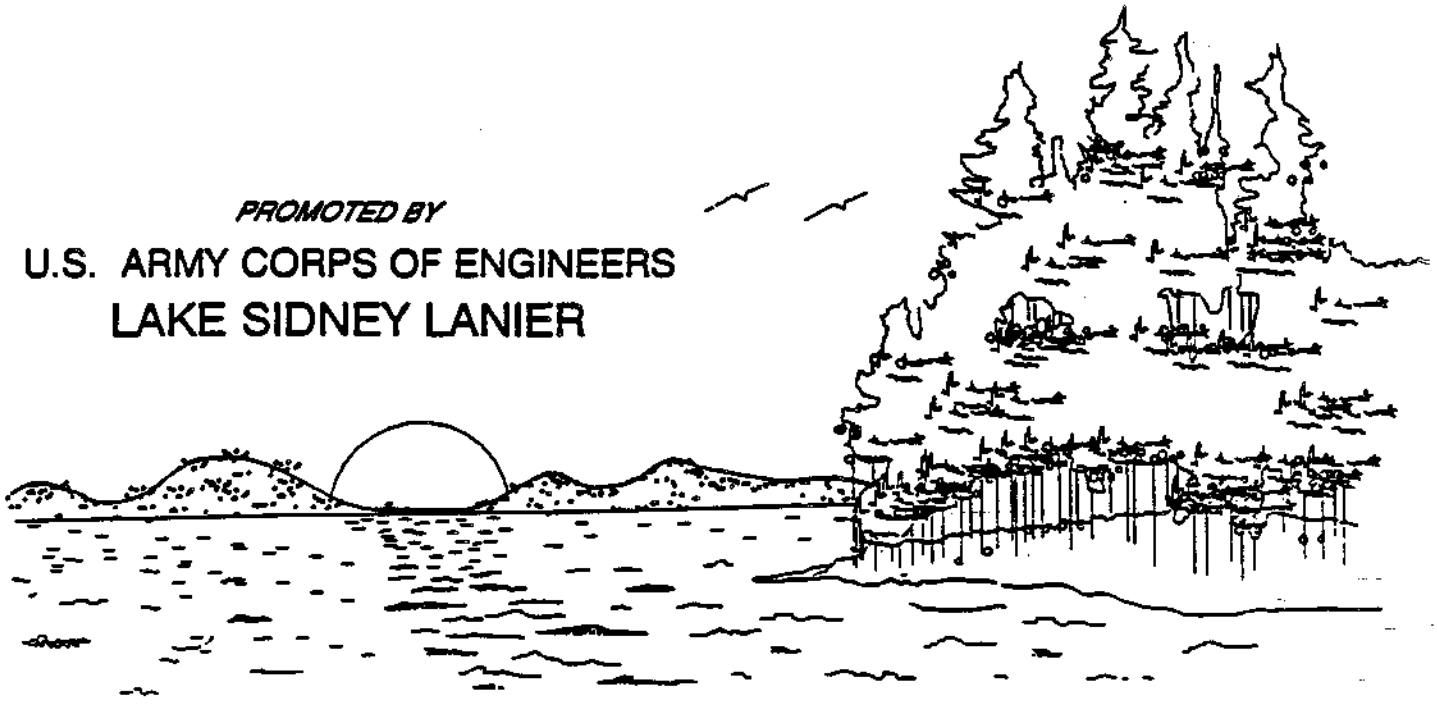
Program was first offered: March 1991

ADOPT LANIER'S FUTURE

PROMOTED BY

U.S. ARMY CORPS OF ENGINEERS

LAKE SIDNEY LANIER



ADOPT LANIER'S FUTURE GUIDELINES
U.S. ARMY CORPS OF ENGINEERS

ADOPT LANIER'S FUTURE is an environmental awareness program sponsored by the U.S ARMY CORPS OF ENGINEERS at Lake Sidney Lanier. The objective of this program is to create public awareness and involvement of the community in taking care of the islands at Lake Sidney Lanier.

Lake Lanier is a precious resource that everyone enjoys. Through the efforts of our local civic groups and community participation, we the people of Georgia can make this lake beautiful and clean for future generations.

ADOPT LANIER'S FUTURE has become a major part of a volunteer network around the lake. Your volunteer efforts have insured the success of this program and we appreciate the time you spend keeping the lake clean for all to enjoy.

HOW CAN YOU HELP?

ADOPT LANIER'S FUTURE needs individuals, civic organizations, corporate groups and neighborhood groups to help us monitor and clean the islands to keep them beautiful. With your individual effort, we can jointly ensure success!

GENERAL GUIDELINES

Through such adoption, an organization would have responsibility of controlling the litter problem on an island. This also includes notifying the Corps of Engineers of any disturbances that may effect the island and the lake. The organization responsibilities are:

- Plan a general cleanup four times a year. Try to visit at least once during each season so you can see "your" island change with the seasons during the year.
- Plan to monitor and give a report of wildlife activities on the island, (Ex. Nesting habitat, etc.)
- Identify native and exotic plant life on the island. (Have a knowledgeable volunteer work with group.)
- Assist the Corps of Engineers in securing media coverage for the program.

- Keep records of your group's volunteer hours. (Volunteer hours form is enclosed in package.)
- Please make every effort to recycle when possible. Some marinas have recycling bins.
- Coordinate with the Corps of Engineers personnel to carry out your plan.

The Corps of Engineers will provide assistance in carrying out the overall plan of the program.

- The Corps will coordinate media coverage to inform the public of the program.
- For those organizations who sign up for a twelve month sponsorship, the Corps of Engineers will provide a plaque to the organization and a certificate to each individual that participated in the program. This will let others know about your service work through media publicity.

SAFETY FOR VOLUNTEERS

All organizations will conduct safety meetings with volunteers to discuss the dangers of working on an island. The discussions should include the proper clothing for working, staying away from wild animals and minor first aid in the woods. (Boots, hats, long-sleeve shirts, etc.)

RULES AND REGULATIONS

U.S. ARMY CORPS OF ENGINEERS REQUIREMENT:

1. All adopting organizations must sign an Agreement for Volunteer Services.

2. The Corps will have final approval on all islands adopted and a volunteer hours sheet will be turned in on a quarterly basis.

3. Adopting organization must pick up litter at least once per quarter. (Four times a year). Quarterly status reports (in packet) are required by the last day of March, June, September, and December. If you are unable to go out to your island during a quarter, please send in a negative report. If you visit your island more than once during a quarter, please fill in a status report for each visit.

4. Adopting organization must advise the Corps two days prior to going to the adopted island.

5. You have an option to renew your adoption agreement after one year.

ADOPTING ORGANIZATION::

1. Civic, non-profit organizations and corporate sponsors.

2. Participants must be at least 12 years of age. If under age of 18, participants must have written parental consent.

3. All organizations must be approved by the Corps of Engineers for the ADOPT LANIER'S FUTURE program.

4. The ADOPT LANIER'S FUTURE status report plus the volunteer Service Report must b forwarded to "Adopt Lanier's Future" coordinator on a quarterly basis. (by the last day of Marc June, September, and December). If you were unable to get out to your island during the quarte please send in a negative report. If you visited your island more than once during the quarte please send in a report for each visit.

SAFETY:

The Corps of Engineers will advise volunteers about personal safety.

The Corps advises Adopting Organizations to:

- Keep work groups to a manageable size.
- Closely supervise youth groups.
- Make sure each person has a life jacket on while the boat is underway.
- Make sure each boat operator follows the Coast Guard Boating Regulations.
- Notify the Corps each time a group goes to an island and the Corps can have a garbage truck pickup at any ramp when the organization comes to shore.
- Do NOT remove any hazardous materials and notify the Corps of Engineers.
- Stay clear of construction areas.
- BE AWARE of old open wells on islands and notify the Corps immediately.
- Hold a safety meeting with group prior to arrival on an island.
- DO NOT go to an island during inclement weather, hours of darkness or small craft advisory warning.
- Be aware of possible contact with poisonous plants, stinging insects, nesting areas, firearms, and snakes.
- Consider the possibility of any participant's known allergies.
- Do NOT allow participants to partake of, possess or distribute alcoholic beverages while involved in the ADOPT LANIER'S FUTURE program.
- Make participants aware that they are working in a potentially dangerous environment and caution them to act accordingly.

EXHIBIT VII

BIBLIOGRAPHY OF SELECTED ENVIRONMENTAL EDUCATION MATERIALS AVAILABLE FOR PURCHASE OR LOAN TO PROJECT

Following is a short annotated bibliography. Current prices reflected are subject to change.

"Water in Your Hands"
Soil and Water Conservation Society, 7515 N.E. Ankeny Road
1-800-THE SOIL Ankeny, Iowa 50021-9764

This publication is in comic book form. A teacher's guide accompanies it. There is also a Spanish version. The society has packets provided by the Soil Conservation Service which include a Native American poster and coloring book written in both English and Native American. The society has several other comic books and teacher's guides on subjects such as land, plants, wildlife, food, and land use. You can get a free sample set of the comic book plus one sample teacher's guide and order form by calling the above number.

"Sport Fishing and Aquatic Resources Handbook" (student manual)
"Aquatic Resources Education Curriculum" (Instructor manual)
AFTMA Sport Fishing Educational Foundation
Future Fisherman Foundation 1250 Grove Ave, Suite 300
(708) 381-4061 Barrington, IL 60010

The student manual contains 14 chapters which includes subjects such as how to catch fish, water pollution, fish identification, fish habitat, fish biology and ecology, etc. The handbook can stand alone without the instructor manual. The student manual is $3.50 with quantity discounts making it as low as $1.80 ea. The instructor manual is $20.00 each. The price drops to $10.00 each with purchase of 21+ copies. An order form is available for other products too.

"American Wetlands"
American Wetlands % Terrene Institute 1717 K St,NW Suite 801
(202) 833-8317 Washington, DC 20006

This is a pamphlet which contains a graphic illustration on the value and functions of wetlands. The brochures are $7 per set of 25. They are willing to give the Corps a discount of half price if 500 are ordered ($70).

"WOW!: The Wonders of Wetlands, an Educator's Guide"
Environmental Concern Inc. P.O. Box P
(410) 745-9620 St. Michaels, MD 21663

This is a guide containing "hands on" activities for students. The entire book deals with wetlands.
1-4 copies are $12.00 ea. 5-19 copies are $10.00 and 20+ are $8 ea.

OBIS (Outdoor Biological Instruction Strategies)
Lawrence Hall of Science, University of California
Berkeley, California
Order from: Delta Education, Inc.
P.O. Box 915,
Hudson, NH 03051-0915
(800) 258-1302

Outdoor learning activities for young people. OBIS modules incude Aquatic Animal Behavior, Breakwaters and Bays, Streams and Rivers, Seashore, and Ponds and Lakes, among others.

"The Young Scientist's Introduction to Wetlands"
U.S. Army Engineer Waterways Experiment Station (WES)

Black and white copy with illustrations on what wetlands are and their functions. Geared for elementary level. A copy is included in the ISOP tool kit.

Water resources education posters
American Water Resources Association
5410 Grosvenor Lane
Suite 220
Bethesda, MD 20814-2192
(301) 493-8600
Cost $5.00 for each poster

Grade school, middle school and black and white posters available. Poster titles are: "Water The Resource that Gets Used & Used & Used for Everything", "How Do We Treat Our Waste Water?" and "Wetlands: Water, Wildlife, Plants & People." Size 2' x 3'

National Wildlife Federation slide shows and videos
National Wildlife Federation 1400 Sixteenth st., N.W.
1-800-432-6564 Washington, DC 20036-2266

For a catalog call above number and ask for "Nature Education Catalog." Prices vary. There are 8 slide shows available and numerous videos. Slide show topics are on water, soil, clean air, wildlife, forests, predators, eagles, and our land.

"Project Wild," "Project Learning Tree," and "Aquatic Project Wild"
Western Regional Environmental Education Council
Salina Star Route
Boulder, Colorado 80302
(303) 444-2390

These are curriculum guides with many "hands-on" activities. Receiving the guides requires persons to attend instructor workshops. Usually these workshops are conducted by state wildlife or conservation agencies. Check with your local state or call above number.