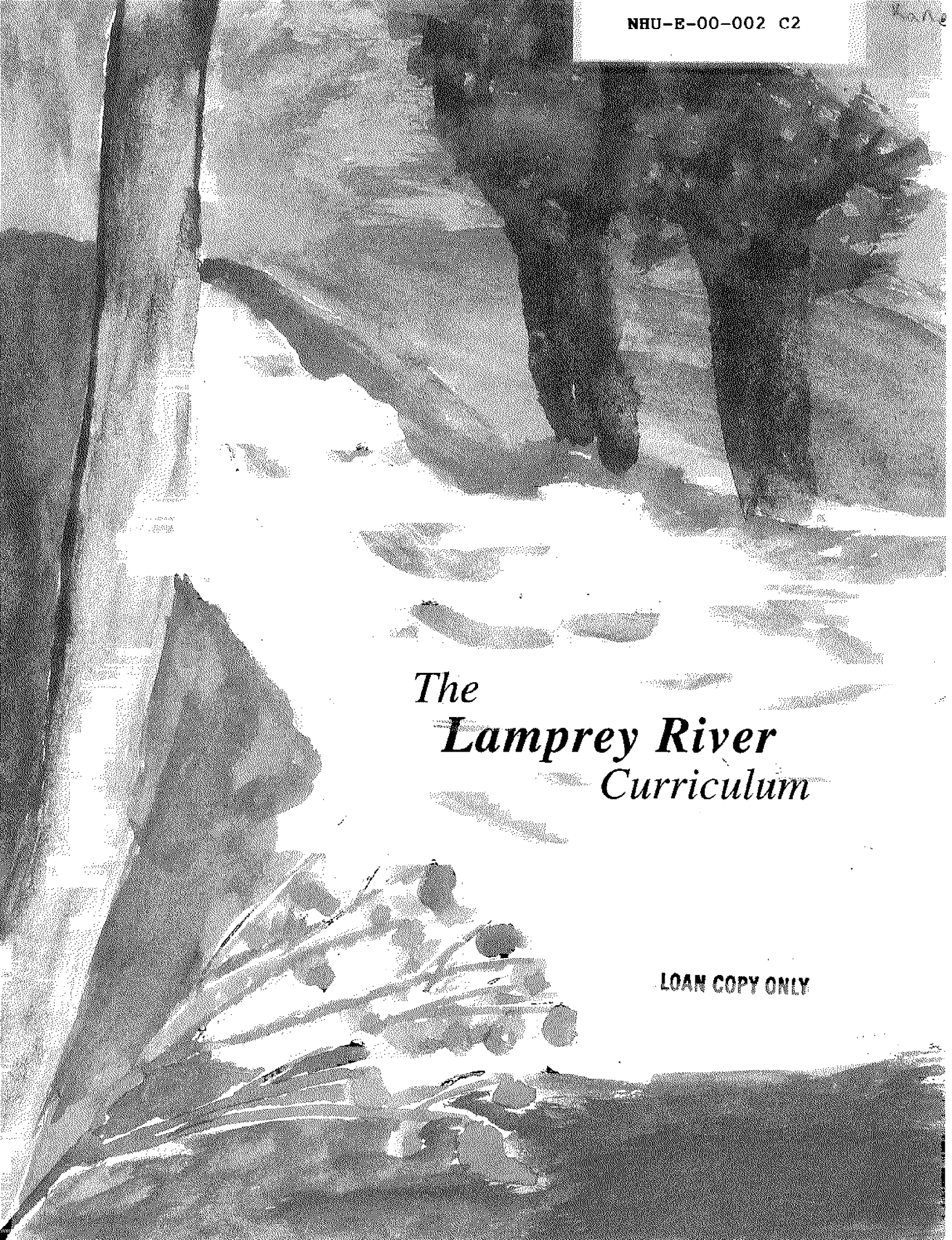

The ***Lamprey River*** *Curriculum*

THE LAMPREY RIVER CURRICULUM

A Teacher-written, Teacher-tested
Social Studies Curriculum with a Science Component
for Elementary School Students

by

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in collaboration with the

Lamprey River Advisory Committee,
Lamprey River Watershed Association,
The Greater Piscataqua Community Foundation,
and the Barbara K. and Cyrus B. Sweet III Fund

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UNIVERSITY OF
NEW HAMPSHIRE
COOPERATIVE EXTENSION

Acknowledgements

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We also recognize that this project could not have come about without the support of the Greater Piscataqua Community Foundation and the Lydia K. and Cyrus B. Sweet III Fund, offered through a grant awarded to the Lamprey River Advisory Committee. The Lamprey River Watershed Association was an important collaborator on the project, as was the University of New Hampshire's Cooperative Extension and Sea Grant Extension programs.

We want to recognize the role Lee Selectman and Lamprey River Advisory Committee member Richard Wellington played, both in conceiving the video that inspired this curriculum, and for being an outstanding resource to the authors. Members of the local historical societies were most helpful, allowing us to peruse some of their historical materials. We particularly want to thank Phyllis Shenefiel, Richard Sanborn, and Kay Williams for their assistance in this regard. Sea Grant Communications Specialist, Steve Adams, assisted in the editing and printing process, and his help was very much appreciated. We also thank Margaret Watkins, staff for the Lamprey River Advisory Committee, who shared information, maps, and other resources with the authors as they wrote the curriculum.

Sam E.

PREFACE

The curriculum is designed to accompany a video, *The River: The Lamprey Through History*, produced for the Lamprey River Advisory Committee by Ideaworks, of Portsmouth, New Hampshire. The video focuses on the ways people have used the river for their livelihood and recreation in the past. The curriculum aims to assist educators and their students in studying the river as a vital part of their cultural heritage. We have broadened the scope of study somewhat by including exercises that focus on the river as a habitat for plants and animals.

Each lesson could conceivably be taught as a separate entity, although we feel that studying the river as a whole is a more valuable experience. The centerpiece of the curriculum is the field trip to sites along the river. We came to value the river as a vital part of our community through directly experiencing the river, as it winds from Northwood to the shore of Great Bay. The field trip and follow-up activities, generated by the educators, parents, and other community members, made this a very important part of the curriculum.

The curriculum has six lessons, or mini-units, with background for the educators preceding the activities that are detailed for the students. The loose-leaf binder format makes it easy to remove and duplicate activity and data sheets. It also encourages educators to add maps, interviews and activities that they develop themselves, in this way adapting it more fully to their own communities.

Finally, if any of the authors can be of assistance to educators who use this curriculum, please do not hesitate to let them know.

TABLE OF CONTENTS

NH Social Studies Standards Supported by This Curriculum

Lesson 1	**The River Runs Wild and Scenic**	6, 7, 8, 10, 11, 12, 13, 14
Lesson 2	**The River Runs Through Life**	11, 14, 15, 16
Lesson 3	**A Map of Our Own**	10, 11, 13, 14, 15, 16
Lesson 4	**Stopping Along the Lamprey**	6, 7, 8, 13, 14, 15, 16, 17
Lesson 5	**A Message to the Lamprey**	11, 12, 13

Curriculum Standard 6: Students will demonstrate the ability to examine the interactions of individuals, households, communities, businesses, and governments in market economies, including competition, specialization, productivity, traditional forms of enterprise, and the role of money and financial institutions.

Curriculum Standard 7: Students will demonstrate an understanding of different types of economic systems, their advantages and disadvantages, and how the economic systems used in particular countries may change over time.

Curriculum Standard 8: Students will demonstrate an understanding of the patterns and results of international trade, including the distribution of economic resources, imports and exports, specialization and interdependence, exchange of money, and trade policies.

Curriculum Standard 10: Students will demonstrate the ability to use maps, mental maps, globes, and other graphic tools and technologies to acquire, process, report, and analyze geographic information.

Curriculum Standard 11: Students will demonstrate an understanding of the physical and human geographic features that define places and regions.

Curriculum Standard 12: Students will demonstrate an understanding of landform patterns and water systems on Earth's surface; the physical processes that shape these patterns, and the characteristics of ecosystems.

Curriculum Standard 13: Students will demonstrate an understanding of the impact of human systems on Earth's surface including the characteristics, distribution, and migration of human populations; the nature and complexity of patterns of cultural diffusion; patterns and networks of economic interdependence; processes, patterns, and functions of human settlement; and the forces of cooperation and conflict that shape the human geographic divisions.

Curriculum Standard 14: Students will demonstrate an understanding of the connections between Earth's physical and human systems; the consequences of the interaction between human and physical systems; and changes in the meaning, use, distribution, and importance of resources.

Curriculum Standard 15: Students will demonstrate the ability to apply their knowledge of geographic concepts, skills, and technology to interpret the past and the present, and to plan for the future.

Curriculum Standard 16: Students will demonstrate the ability to employ historical analysis, interpretation, and comprehension to make reasoned judgments and to gain an understanding, perspective, and appreciation of history and its uses in contemporary situations.

Curriculum Standard 17: Students will demonstrate a knowledge of the chronology and significance of the unfolding story of America, including the history of their community, New Hampshire, and the United States.

NH Science Standards Supported by This Curriculum

Lesson 4 **Stopping Along the Lamprey** 1a, 2a, 2b, 2c, 3b, 6d

Curriculum Standard 1a: Students will demonstrate an increasing understanding of how the scientific enterprise operates.

Curriculum Standard 2a: Students will demonstrate an increasing ability to use measuring instruments to gather accurate and/or precise information.

Curriculum Standard 2b: Students will demonstrate an increasing ability to use technology to observe nature.

Curriculum Standard 2c: Students will demonstrate an increasing ability to analyze, synthesize, and communicate scientific information using technology.

Curriculum Standard 3b: Students will demonstrate an increasing ability to understand how environmental factors affect all living systems as well as species-to-species interaction.

Curriculum Standard 6d: Students will increasingly quantify their interactions with phenomena in the natural world, use these results to understand differences in scale in objects and systems, and determine how changes in scale affect various properties of those objects and systems.

Introduction to the Lamprey River

How did the river get its name? The Native Americans called it the Pascassick, a name that is now confined to its small tributary in Newmarket, and is generally written Piscassic. In 1639, in some records found in Exeter, it was called the Lamprill and Lamprel river. On a map drawn in 1680, a replica of which hangs in the Mast Way School library, it is labeled Lamper River. The lamprey eel, a fish that lives in the river in the early part of its life and then swims out to sea, returning only to spawn, may have been the source of the river's name. No one knows for sure.

The Lamprey River runs 47 miles from Betty's Meadows near Saddleback Mountain in Northwood Meadows State Park. It includes significant tributaries and lakes along its way. The river's watershed is 212 square miles and includes the communities of Candia, Raymond, Deerfield, Northwood, Nottingham, Epping, Lee, Durham, and Newmarket.

Its many dams speak to its mill heritage, for the river drops more than 600 feet in elevation on its way to the Great Bay and has many waterfalls that lend themselves to the development of waterpower for manufacturing. Raymond, Epping, Lee, Durham, and Newmarket were all sites of major water-powered industries such as grist, cider, cloth, and lumber mills.

As the river winds its way to the estuary, there are undisturbed places providing habitat for a variety of wildlife. A visitor to the river might be surprised by the slap of a beaver tail or the swish of an otter as it slides into the river. The 150 or more bird species that have been sighted along the river mean that one can see a variety of songbirds, ducks, and an occasional great blue heron. Migrating birds find its shores to be critical resting and feeding places as they move north or south. Stepping quietly along, one might encounter one of the state's six turtle species that reside in wetlands and uplands, along the banks of the river. There are fishers, weasels, porcupines, deer, moose and even an occasional black bear frequenting the woods that abound in the river corridor.

The Lamprey's waters are home to trout, largemouth bass, pike, and white and yellow perch, to mention a few of the species that attract fishermen from April through September. As Judith Spang mentions in her article in the *Lamprey River Watershed Guide*, "The Lamprey is a truly exceptional river.... It contains every type of stream and river fish you could expect to find in New England."

Freshwater mussels trail through the sand and indicate a healthy river environment with swimmable, fishable waters, little sedimentation, few sudden water withdrawals, and undisturbed shoreline vegetation to provide shade. Six out of the nine river mussels found in New Hampshire grow in the Lamprey, and because they are so sensitive to slight degrees of pollution, their presence assures

us that the Lamprey is healthy.

Canoers and kayakers look forward to "ice-out" every year when the river rises and provides a challenge to the most experienced paddler. Yet, there are many quiet, calm sections where one can paddle quietly along. Parks and conservation areas in many of the communities along the river are places to go for a quiet walk or picnic. Although there are few public beaches, swimmers find their way into the cool waters on a hot summer's day.

The value of the Lamprey was formally recognized a decade or more ago when New Hampshire included it as a "rural" river in its River Protection program. The Lamprey River Advisory Committee was formed at that time. Their work, in collaboration with other groups such as the Lamprey River Watershed Association and concerned citizens and town officials in many of the communities along the river has resulted in increased oversight and protection for the river. A part of the Lamprey River in Newmarket and all the portions in Durham, Lee and Epping have been designated within the National Parks' Wild and Scenic Rivers program. This protects local control of the river in those communities. Signs at highway crossings along those parts of the river inform the public of its wild and scenic status. Some funds have been secured as a result of these efforts to assist in development of recreation areas for the public and land protection strategies for homeowners along the river.

Still, the Lamprey is vulnerable, particularly to the population pressures that are fast developing in New Hampshire. The more people move into the area, the more the river is subject to all sorts of pollution. Point source pollution, that comes from specific sources such as discharge pipes from homes or factories, does occasionally occur on the river.The wastewater treatment plants in Epping and Newmarket are the only two regulated discharge points. Both release treated wastewater directly into the Lamprey. Non-point source pollution which comes from failed septic systems, construction sites, dumps, lawn run-off, fields and streets, is washed into streams and the river with every rain.

The Lamprey mirrors the rivers of New England through its historic connection to people who depended upon rivers for their livelihood and recreation. From the time the last glacier covering this area melted 12,000 years ago, people have utilized the river's resources and continue to do so. It is hoped that through study of this river young people will come to understand the value of rivers to them personally, and do their utmost to preserve them for themselves and future generations.

Lesson 1

The River Runs Wild and Scenic

1.1 Thinking and Talking About Rivers.

Overview:
Encourage the students to relate their own experiences with rivers and develop a readiness to begin to study the Lamprey River through discussion, pictures of rivers, etc. Bring in appropriate information that you have from other sources. Help the students organize their information and questions. In the second lesson, begin to develop knowledge of the Lamprey through map-reading activities. The three maps used in this section: a blank map of New Hampshire, a detailed map showing the rivers, and a map of the Lamprey River watershed, are at the end of this lesson.

Focus:
What is interesting about a river?

Learning Objectives:
The students will:
- recall and discuss knowledge of rivers from their experience.
- connect previous knowledge with information and ideas about rivers

Duration:
2 hours

Materials:
___*A River Ran Wild* by Lynne Cherry
___6 sheets of large chart paper
___markers
___materials to make student journals (some may prefer to use folders)

Procedure:
1. Ask your students to share what they know about rivers. Prompt the discussion with questions such as:

Do any rivers run through your town?
Are there any rivers near your school or your home?
Have you ever visited a river? What did you do there?
How did most people use rivers in the past?
Are they as important to us now as they were in the past? Why ?
How are rivers important to other living things?

2. Record your students' ideas on charts under the following topics.
What do we know about rivers? What would we like to learn? How are rivers used today? How did people use them in the past? How are rivers important to other living things?

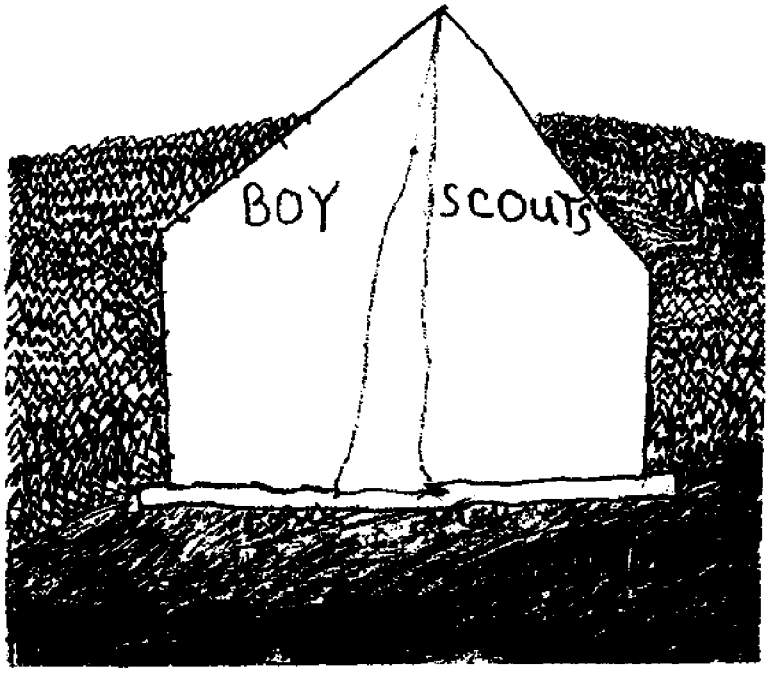
3. Read *A River Ran Wild* aloud. Then ask your students to make connections with information in the book to the discussion you had previously. As they share their thoughts, add more ideas to the different categories.

4. Have your students create and label their *"The River: The Lamprey Through History"* journals. Then have them write about their memories of rivers. (You may want them to share any other memories they have of rivers before beginning to write.) When everyone is finished writing, have the children read aloud or share portions of their memories.

THE RIVER

by Chelsea K.

Peaceful and gentle is the sparkling stream.
Soft music glides over the river bed.
While white water crashes through the canyon.
Twisting and turning with booming thunder,
The river from beginning to end,
And somewhere in the middle
Splashing, dashing, castles of foam.
The sapphire stream goes on forever.



1.2 Where is the Lamprey River?

Overview:
The Lamprey River stretches 47.3 miles from its headwaters in the Saddleback Mountains at Betty's Meadows in Northwood to the shores of Great Bay in Newmarket. It is the fourth largest river in the state and its watershed covers 212 square miles. It drops 600 feet in elevation on its way to Great Bay and discharges 278 cubic feet of water per second. Its major tributaries are Hartford Brook, North Branch River, Onway/Governors Lakes tributaries, Pawtuckaway River, North River, and the Little River. Towns in the watershed include Northwood, Candia, Raymond, Nottingham, Deerfield, Epping, Lee, Durham, and Newmarket.

Focus:
Locating the Lamprey River in the state.

Learning Objectives:
Students will:
• demonstrate the ability to gain a variety of information from several maps.

Materials:
___Blank outline maps of New Hampshire
___Detailed maps of New Hampshire showing the Lamprey River (1 for 2 children)
___Maps of the Lamprey River watershed, (1 for 2 children)
___Crayons or colored pencils
___Charts to record class discussion items.

Procedure:
1. Ask your students to share their ideas about the location of the Lamprey River. Where can they see the River in your town? Does it flow through any other towns? Which ones? What else do they know about the river's location? Where do your students think the river is in the state?

2. Give each child a copy of the blank New Hampshire map and ask them to draw the location and extent of the Lamprey River. (They can also try to place the river on a map at the end of the project for evaluation.)

3. Pass out detailed maps of New Hampshire which show the location of the Lamprey River. Ask your students to work in pairs and find the river on these maps, trace it with crayons, and then compare their drawings of the river on the blank map with its true location. Have them rank their drawings: close, somewhat close, not close.

4. Hand out maps of the Lamprey River watershed and have your students trace the length of the river with crayons. Provide them with string and a ruler to make measurements on the map. They can be quite accurate if they work

together to hold the string down all along the path of the river from beginning to end and measure the string. They can compare their measurements with the legend at the bottom of the map.

5. Introduce the concept of a watershed as the entire land surface that drains into a river, lake, bay, etc. Have the students study the watershed map, and then ask them to decide what they can learn about the river by looking at it. Generate a list of topics. Write the topics on chart paper or on the board.

6. Discuss the term "data" with the students and have them label the next page in their journals "Map Data."

7. Ask them to write the topics that were generated in #5, leaving several lines after each topic, in their journals. Encourage them to record the information they gathered from the maps. Topics can include: length, direction, tributaries, towns in the watershed, where it crosses their town, beginning and end of the river, etc.

8. Now give your students time to gather as much information as they can from the maps.

9. As a whole class, compare what was discovered about the river using the watershed maps. Students may fill in information they missed. During the discussion, add information to the charts begun earlier in part 1.1.

The Lamprey

by Greg G.

From Northwood to Great Bay,
The Lamprey flows.
From places far away,
Past houses and roads it goes.
The creatures in the Lamprey
They swim or crawl or fly.
They depend upon the river
Until the time they die.

Lamprey River Map Data

Student's name_____ **Date**_____

How long is the river? _____miles.

What general direction does it flow?_____

Does it change direction? _____ Describe how. _____

_____

Where does the river start?_____

Where does it end?_____

Where is the river located in the state?_____

_____

Does the river have tributaries? If so, name some. _____

_____

What other things did you learn from the map?_____

_____

_____

Raging Current

by Sam H.

The current is swift with castles of foam,
Sparkling, splashing, twisting and raging.
But some of the river isn't in motion. It's not
Splashing or rolling or tumbling or thrashing.
It sits in the pond, not moving at all,
Waiting to move South to the next waterfall.
Near where it sits were mills and the falls.
Producing food for the villages all.
After the water flows over the obstacles
And through the towns,
It ends up in the sea.

Lesson 2

The River Flows Through Life

Overview: This lesson focuses on the many ways the people along the Lamprey River have used it in their lives from the past to the present. Students need an understanding of the roles the river has played throughout history so that they will understand why they need to help ensure the health and vitality of the river in years to come. In this lesson students will be able to see and hear about the communities through which the Lamprey River flows. They will view a video and complete viewing activity sheet to increase their knowledge and appreciation of the Lamprey River.

Focus: How have people used the river to benefit their lives through history to the present?

Learning Objectives: Students will be able to:
- identify the communities through which the Lamprey flows.
- explain different uses made of the river by people and other living things.
- identify some types of wildlife found along the Lamprey.

Duration: 1 hour

Materials:
___Copy of *River Story: The History of the Lamprey River* video
___Television and VCR
___Copy of the Video Viewing Activity sheet per student
___Sheet of paper per student
___Pencils

Previewing Activities:
1. Have students look at the individual maps they created as part of Lesson 1 (or give them maps showing the rivers of the state.) Ask students to discuss what they discovered when they completed the maps or what they noticed about the Lamprey River on the maps they have been given.

2. Have students generate questions they would like to have answered about the Lamprey river on a separate sheet of paper. Collect the papers to be used after the viewing of the video.

Focus for Viewing: Read through the questions on the viewing sheet with the students and ask them to pay close attention during the video in order to complete the activity.

Video Viewing Activity

Begin the video at the start of the tape.

PAUSE: When the watercolor of the flying geese appears on the screen and the narrator completes his sentence, have students record the three reasons the river was essential in early times. Resume play.

PAUSE: When the black-and-white photo of the Native American appears on the screen, ask students to complete the second question regarding how long ago Native Americans lived along the Lamprey River. Resume play.

PAUSE: As the small painted turtle begins to move across the screen, have students list five different animals they might find along the Lamprey River. Allow time for students to share answers to ensure all of the animals shown are noted. Resume play.

PAUSE: After the fawn gets up and begins to move across the screen have the students answer the question concerning the community in which the Lamprey River begins. Note that the question is asking for the community and not the exact location. Resume play.

PAUSE: When the black-and-white photo with the green box titled Deerfield/ Recreation appears, have students predict two ways the river may be used for recreation. Resume play.

PAUSE: When the black-and-white photo with the green box titled Raymond and Candia/Early Mills appears, have students discuss whether or not their predictions were correct. Resume play.

PAUSE: After the narrator says, "... many lines linked New Hampshire towns," and the railroad station appears in the background, have students list two ways New Hampshire people used mills along the river. Resume play.

PAUSE: After the block of ice is directed into the icehouse by the man sitting along the chute, ask the students to record their ideas as to why ice cutting was important to the lives of people living along the river in the late 1800's and early 1900's. Resume play.

PAUSE: After the narrator says, "... straddled the entire river and used a horizontal waterwheel," have students note on their viewing papers the only location along the Lamprey where this situation was located. Resume play.

PAUSE: After the narrator says, "... that employed 15 people," and the water is shown flowing over the dam, have students list three different items which were

manufactured at the Wiswall Dam site. Allow time for students to share their ideas. Resume play.

PAUSE: After the narrator says, "... river town of Newmarket." Have students complete the question regarding where the Lamprey River ends its journey to the ocean. Resume play for the completion of the video.

After viewing of the video is complete, redistribute the question sheets generated earlier. Ask students if there are still any questions that were not answered as a result of watching the video. In the event that there are, determine the relevance of future research by your students or provide the answers yourself. The listing of resources made available in the appendix may be useful.

Be sure to show the video without interruption at some time during the unit.

River Changes

by Sam E.

Sometimes the river changes in many, many ways.
Like it could slide or crash or collide,
Or sometimes it could be smooth and soft and calm.
It's really, really strange how these things are so,
But that's just the way it goes.

The Waterfall

By Jonathan.

The river is winding like a snake,
Twisting and flowing into a clear lake.
The lake turns into a splashing and wild waterfall,
At the bottom of the waterfall,
The river becomes bubbling, crystal dewdrops...
And the river shivers.

Video Viewing Activity

Student's name_____ **Date** _____

Listen carefully to the video *River Story, The History of the Lamprey River* that your teacher is going to show you. When the tape is paused, answer the appropriate questions below.

1. List the three reasons the Lamprey River was essential in early times:

   a) _____

   b) _____

   c) _____

2. How many years ago did the Native Americans live here? ____

3. List five different animals you might find along the Lamprey River:

   a) _____

   b) _____

   c) _____

   d) _____

   e) _____

4. In which community does the Lamprey River begin?

   _____

5. Predict two ways that the Lamprey River might be used for recreation. (How would you like to use the river?)

   a) _____

   b) _____

6. List two ways New Hampshire people used mills along the Lamprey River:

a) _____

b) _____

7. Why do you think that ice cutting was so important to the lives of people living along the Lamprey River in the late 1800s and early 1900s?

_____

_____

_____

8. What is the only location along the Lamprey River at which a dam straddled the entire River and a horizontal waterwheel was used?

_____

9. List three different items that were manufactured at the Wiswall Dam site:

a) _____

b) _____

c) _____

10. In what community does the Lamprey River end its journey to the sea?

_____

11. Use the space below to write about the two facts you found to be the most interesting about the Lamprey River.

Lesson 3

A Map of Our Own

Overview:
This lesson focuses on the creation of a large area map of the Lamprey River watershed that includes all of the communities through which the River flows, significant historical and local events, and sites that have played a role in the Lamprey River's history. Animals and plants that the students have noted from the video may be added also. Be sure that the students understand that a watershed is land from which all the water drains into a certain stream, river, lake or other water body. On its way, the water travels across farm fields, forest lands, parking lots, lawns, highways, town streets, school playgrounds, and fields. Students will be encouraged to work collaboratively to produce the map for a classroom or hallway display. As the students learn more about the river, they can add items to their part of the map and display.

Focus:
What were some of the important events, places and people in history to the present time in the Lamprey River watershed?

Learning Objectives:
Students will be able to:
- generate a portion of a large map.
- contribute important information for display on the map.
- identify tributaries and other important land features along the River.
- note locations of historical events along the Lamprey River.

Materials:
___Overhead projector with overhead copy of the watershed map *OR*
___Opaque projector and copy of the watershed map (Lesson 1.2)
___*River Story: The Lamprey Through History* video
___Television and VCR

For Each Working Group
___large butcher or bulletin board paper
___masking tape
___pencils
___colored markers

Procedure:
1. Divide your class into seven working groups. Each group should be assigned one of the seven communities through which the Lamprey flows.

2. Using an opaque or overhead projector, project the map onto a wall surface that has been covered by a large piece of butcher or bulletin board paper. Demonstrate for the class how to outline the boundaries of a single community, and then how to trace the Lamprey River and its tributaries onto the butcher paper.

3. In turn have each group trace their community boundary, the Lamprey River through their community, and any tributaries or contributing water sources that flow from their assigned community onto the paper.

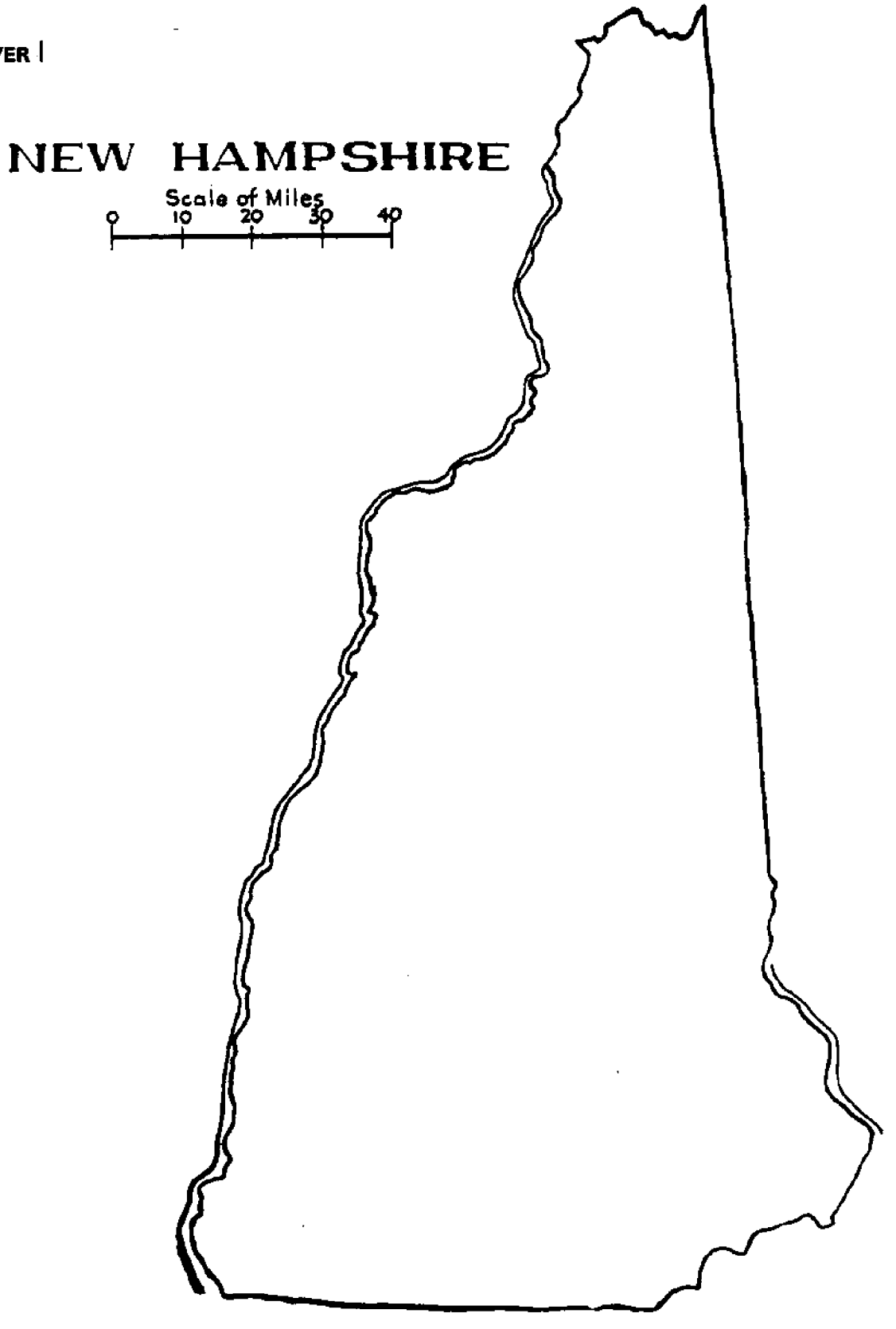
4. While each group in turn is working with the enlargement, other groups should be reviewing information they have learned about their communities through the video, and deciding how that information could be added to the large Lamprey River map being created. Making available the list of resources noted in the appendix will be helpful.

5. After each working group has completed their segment, piece the segments together for a hallway or classroom display of the river. Students may wish to present the map and its progress to other classes.

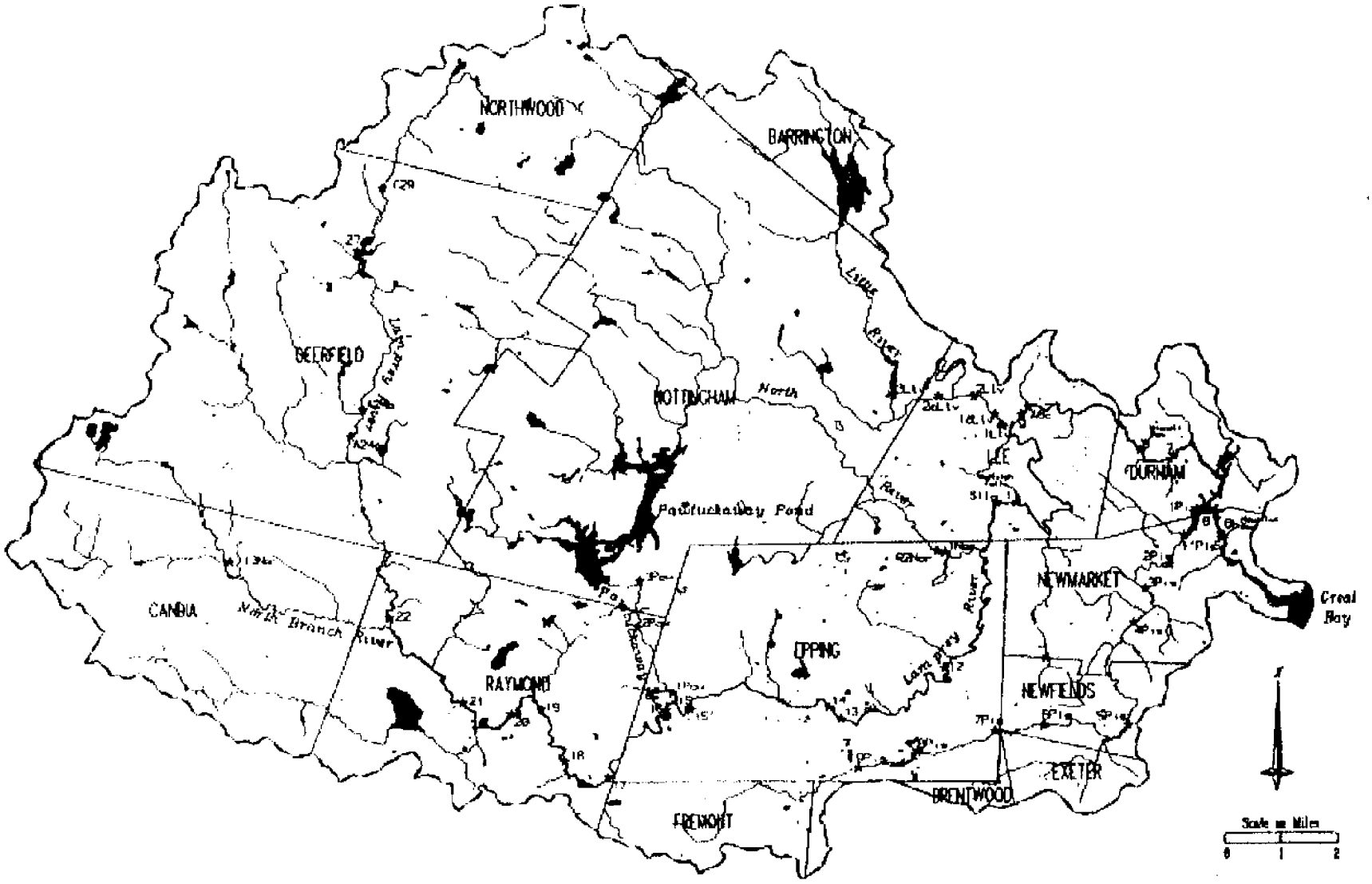
6. Throughout the duration of the unit, students should continue to add information to the large map so that it becomes a visual memory of their study. Examples might include the location and names of dams created, garrison houses built, activities that occur along the river, sites of artifacts discovered or even a student's favorite swimming hole. Students should be encouraged to include both historical as well as current information. The more information added, the more exciting the river becomes to view and discuss. If possible, keep the video available for students to use throughout this portion of the project.

Blank Map of New Hampshire

River I



Lamprey Watershed Map


NORTHWOOD
BARRINGTON
DEERFIELD
NOTTINGHAM
Pawtuckaway Pond
LEE
DURHAM
NEWMARKET
Great Bay
CANDIA
North Branch River
RAYMOND
EPPING
NEWFIELDS
EXETER
BRENTWOOD
FREMONT
Scale in Miles
0
1
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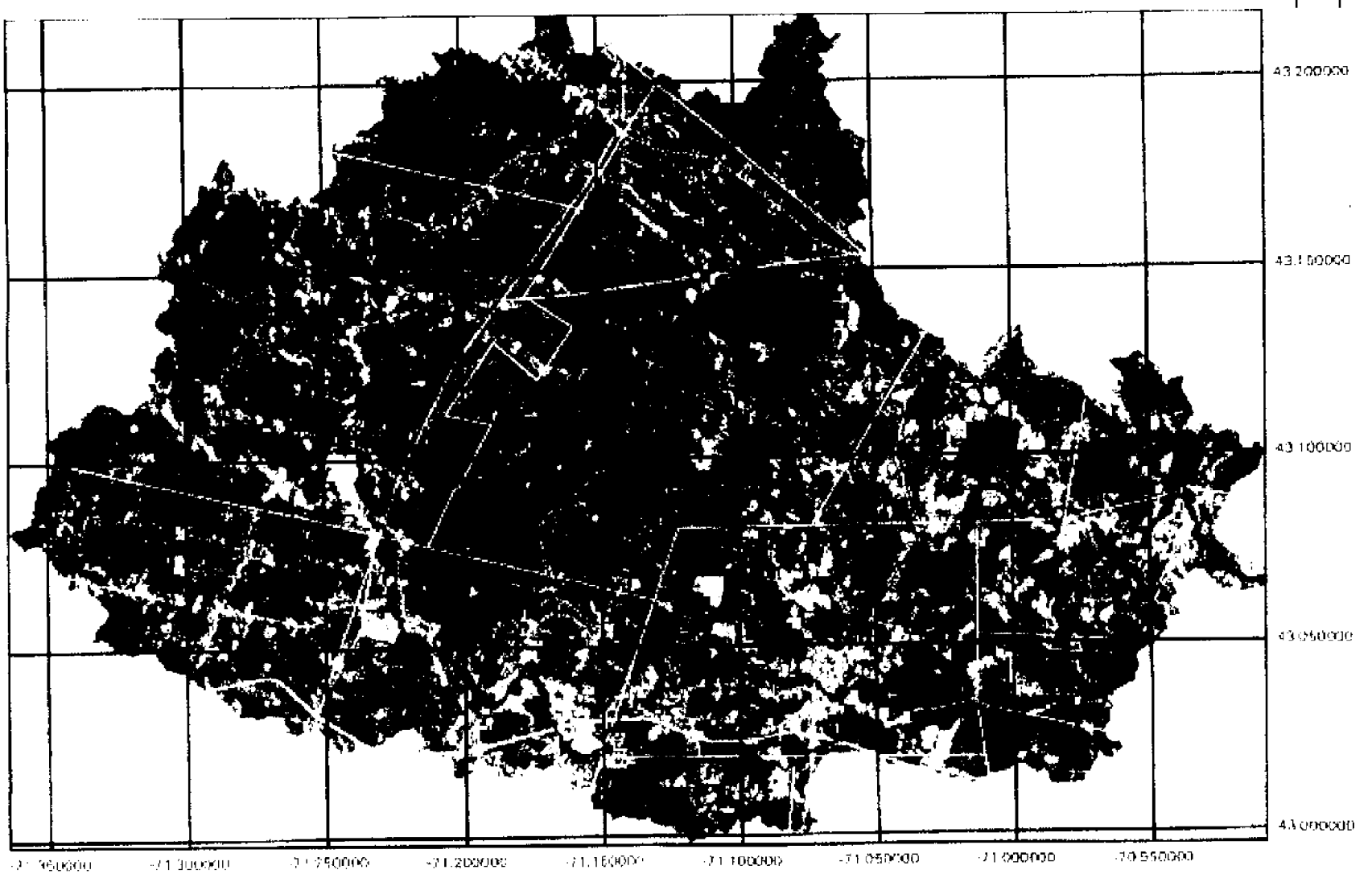
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-71.100000
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-70.950000

Stopping along the Lamprey Field Trip

Overview: This lesson focuses on taking children to the Lamprey River and allowing them to experience the River from a number of different locations. Included in the lesson are suggestions for completing several field studies that allow students to build and use a variety of monitoring tools to measure physical, chemical, and biological properties of the river.

Learning Objectives: Students will be able to:
- enhance their understanding of the river and its watershed
- build monitoring tools for use on the Lamprey River
- use monitoring tools appropriately to sample basic parameters of water
- collect samples and make observations of animal and plant life along the river

Materials for Each Class:
___Bus or transportation
___Permission slips
___First Aid Kit
___Name tags for everyone (including chaperones)
___Moistened towelettes to clean hands
___3 plastic containers with covers, to take water samples.
___Ziploc bags (large and small) for leaf, rock, and dirt samples
___Pencils
___Clipboards for attaching data sheets
___Dissolved oxygen kit and bucket with rope attached to the handle for collecting water
___pH kit
___Measuring rope for current measurement
___Markers (permanent) to label bags
___Laminated map of the Lamprey River watershed
___Data collection sheets
___Global Positioning System instrument (optional)
___Appropriate monitoring tools (see individual lists for each activity)
___Binoculars
___Field guides for trees, plants, insects, birds, etc.
___Laminated experiment sheets
___Cell phone (optional, but very handy in case of emergency)

Procedure:

1. Select the sites for the field trip and visit them before taking the students on the trip. Time how long it takes to get from one location to another and remember that it generally takes about 5 minutes to load and unload buses with passengers. Be sure that you have written accurate directions for the bus driver.

2. Minimally, classes should view the headwaters of the Lamprey at Betty's Meadows in Northwood, and the closest point accessible to the end of the Lamprey River in Newmarket, at Heron Park. These sites plus additional sites are listed in "Notes for the Teacher" at the end of this lesson. **Teachers are urged to seek out safe, interesting points in their own towns and visit them to check for suitability and safety before taking their students there.**

3. Inform the town offices that control sites where you may be visiting. Make arrangements for gates to be opened if necessary. Sometimes local conservation commissions can put you in touch with people in the community who can act as naturalists for your field trip.

4. Plan for bathroom and lunch stops along the way.

5. Arrange for transportation to chosen sites for the field trip. Often the bus can be provided free of charge if you plan your trip within the time limits that the bus will be available to the school.

6. Contact parents and other community people to act as group leaders for student research teams. One adult for every 3-4 children is a good ratio. Prepare a written field trip schedule for them and be sure they understand what they are to do on the trip. If possible, invite them in to assist the students when they are practicing their field trip experiments in class. It may also be useful to invite them to view the video tape with the students as preparation for the field experience.

7. Review information about the river, goals and instructions before the field trip. Be sure the students know what group they will be in and who their chaperone will be.

8. Upon arrival at a site, have everyone gather together to hear a short site description, a review of safety measures, and purpose of observations and experiments at that particular site. Then have them get into their groups before going to the location.

9. **Important:** follow up the field trip with classroom activities that involve identifying and classifying specimens, using microscopes to look at water samples, using magnifying glasses to look at soil samples, etc. Use the data sheet records or other notes taken on the field trip to add information to the charts and watershed map created in previous lessons. Discuss relationships between plants and animals and the environment. Invite chaperones to assist the students in class. They are often interested in coming to the classroom to help with follow-up activities.

Field Trip Suggestions

(Consult the Lamprey River Watershed Guide for other ideas for field trip sites along the river.)

Some Suitable areas:
Northwood Meadows State Park (headwaters at Betty's Meadows)
Friese's Pond—Deerfield * (The elementary school is very near this location)
Raymond School—Raymond *
Wiswall Dam—Durham
Foss Farm—Durham *
Sliding Rock Park—Newmarket
Wadleigh's Falls—Lee (with the permission and assistance of the Meekers, who live nearby.)

Mast Way School's field trip included four locations:
Northwood Meadows State Park; John Folsom Conservation Area in Epping;
Meeker residence at Wadleigh Falls in Lee; and Heron Park in Newmarket.
Notes from the participating teachers are in ***italics*** after each site.

Directions:

1. Headwaters, Betty's Meadows, Northwood Meadows State Park
From the Lee Traffic Circle travel west on Route 4.
In Northwood turn left onto Route 43. (The library is on one side).
Go 1 mile on Route 43.
Turn right onto Old Mountain Road.
Drive to the end of the asphalt (about 1.5 miles) and park.
Caution: turning the bus around here is difficult, but it is possible.
It takes about 15 minutes to travel there from the Lee Traffic Circle

Mast Way School classes spent 45 minutes collecting data at the headwaters. Students easily conducted oxygen, acidity, temperature, and current speed tests at this site. There was no current, but testing it offered a good comparison for data that was collected at other locations. Water samples we collected contained daphnia and many other small organisms which were interesting to study later in the classroom. Because of the dam at one end, the water was very still. The vegetation included water lilies and other swamp-like plants that provided a good contrast for those in swifter-moving waters at later field trip sites. We found signs of animal life: deer and rabbit tracks, woodpecker holes in trees, and beaver and muskrat homes in the water or banks.

2. John Folsom Conservation Area, Epping
Return on Mountain Road and turn right on Route 43.
Turn left onto Routes 107 and 43 at the stop sign.
Soon after this turn the bus will pass Freese Pond and Dam.
Stay on Route 107.
Bear left where Old Route 101 and 27 joins Route 107.
In Raymond, take Route 27 to West Epping.

Turn right at the sign for the John Folsom Conservation Area.
The Conservation Area is a short distance down this road.
Drive slowly!
It takes about 35 minutes to drive from the headwaters to the John Folsom Conservation Area.

Small pine trees have been planted at the entrance of the Conservation Area. The path passes through a wooded area, crosses a biking or hiking trail that was once a railroad bed, and then enters another wooded area before reaching the river. We found clumps of cinders: evidence that trains once passed through this site. As we came near the old railway, we saw many blackened and dead trees standing or laying on the ground. Insects had attacked them, birds had probed for insects, and larger animals had made homes in or beside them. Hemlock, red pine, cedar, maple, oak, ash and birch trees live there. Many types of mushrooms and other fungi grow closer to the river. Witch hazel was everywhere and in bloom for our October visit. Colonists named this shrub "witch" hazel because they thought it was unnatural for any plant to be blooming in the fall rather than in the spring. Witch hazel yields an astringent still used today. Our classes spent about 1 1/2 hours at the Folsom site. Students conducted oxygen, acidity, temperature, and current speed tests here, and then collected water samples for viewing with microscopes back in the classroom.

Caution: *Do not let the students walk along the railway because they will come to an old railroad bridge that is very dangerous. The railings and floor of the bridge have many open holes. We didn't even go within sight of it!*

3. Wadleigh Falls at the Meeker residence in Lee
(Mrs. Meeker was a naturalist for us and we parked our bus in the driveway and walked down to the Falls. Permission to use any private property must be obtained before planning to use it as a part of the field trip.)

Directions:
Return to Route 27, and turn right toward Epping village.
Proceed to Route 125.
Turn left toward Lee.
Turn right on to Highway 152.
Turn right and cross the bridge over the Lamprey.
The Meeker house is the second house on the left. (It is yellow with a red barn behind it.)
Park in the circular drive beside the house

After getting off the bus, our classes were re-organized into their groups and walked down to view the falls, take samples and do experiments and make observations in their notebooks. It is important to have the chaperones supervise the students very well in this location, since the river flows quickly here. This is not an appropriate site when the river is high in the spring. It is available only with permission and presence of Mrs. Meeker. The students were excited about seeing the supports for an old flue, parts of the dam, the island where Native Americans

camped when they came to fish, and the depressions in the bank where vats holding chemicals to prepare leather were placed. There was a small pile of old leather scraps, remains of an old wagon, bits of crockery, fishing line, beverage cans, and other evidence that humans have used the area from the past to the present time. Wadleigh Falls is the only known site along the Lamprey where a horizontal water wheel was used. We stayed there about 45 minutes.

4. Heron Point Sanctuary (near the mouth of the river), Newmarket

Leaving the Meeker driveway, turn left on Route 152 in Lee and continue to Newmarket.
In Newmarket, turn left onto Route 108 and continue over the bridge.
Immediately after crossing the bridge turn right onto Bay Road.
Drive about 1/2 mile until you come to a mobile home park.
Turn right and drive into the mobile home park.
Drive a short distance to the Heron Point Sanctuary.
Turn right onto the dirt road and continue to the parking lot.
Gather and study the sign with a map of the sanctuary.
Then, keeping the students on the upper outlook platform, look across the river at the Newmarket mills.
This drive takes about 30 minutes.

We only stayed here for 15 minutes, but suggest that a longer period of time be allowed for this stop. Behind the map a wooden stairway and a large platform. From the platform you have a great view of the Newmarket mills and the Lamprey River. We walked to the platform, then talked about the history of this site and observed the differences in the river. (We didn't conduct any tests here because the banks are steep but you could conduct tests at the public landing on the other side of the river at the Newmarket public boat landing next to Joyce's Kitchen. There you would see the historic fish wier and a kiosk describing town history, including old photos and maps.) The vegetation along the trails was different than at the other two sites. Huge boulders were scattered throughout the area and a thick stand of hemlocks covered the hillside. (It would be useful to carry a map that shows the river ending in Great Bay.) The map in the parking lot showed the location of a Native American grinding stone used to grind seeds for flour. Looking for the grinding stone would be a fascinating ending to your trip.

The River

By Bradley W.

The river,
The river,
The ongoing rivr.
It winds its way through
Hills and valleys,
Bubbling its way through
Its rocky bed.
It sometimes flows quietly,
While other times, roars madly.

Teacher's Guide for Experiments and Observations

Overview: These experiments focus on physical and chemical characteristics of the Lamprey River which students can observe, measure, record and compare. During the pre-field activities students have an opportunity to practice measuring skills or make specific equipment to use in the field. After gathering and recording information in teams, students have the opportunity to share the data they have collected to develop a "bigger" picture of the significance of what they have discovered.

Learning Objectives: Students will be able to:
- build and use a number of monitoring tools,
- observe, measure and record physical, chemical, and biological properties of the Lamprey River, and make accurate statements about their relationships.

Preparations: During the pre-field and field experiments students will measure the following properties of the Lamprey River in one or two locations and record their findings on the data sheets at the back of this section.
- Current speed (stopwatch, measured rope, 20 meters long)
- Air and water temperature (2 thermometers with both Celsius and Fahrenheit scales
- Dissolved oxygen (La Motte Dissolved Oxygen tablets kit or CHEMets Kit)
- pH (pH test strips or LaMotte or Hach pH kit)
- Transparency of water (Secchi disk)

Procedures:
Pre-field experiment:
1. Collect all the necessary materials to conduct the experiments and study the Teacher Background information preceding each Student Experiment.

2. Discuss with the class the characteristics they are going to measure and why they are important to animals and plants that live in the river habitat.

3. Divide the class into 5 research teams. Each group will choose a **recorder** to write down information on the data sheet, a **technician** to be responsible for the equipment before and after the experiment, two **scientists** to conduct the experiment, and a **presenter** to share the information with the rest of the class.

4. Distribute the appropriate experiment information, equipment, and Data Sheet #8 on a clipboard to each group. Laminating the experiment information on stiff paper is helpful and can be easily handled by the students in the classroom and the field.

5. If possible, have an adult work with each group. Inviting the chaperones who will be going on the field trip to come in and assist the students in the classroom is a good opportunity for them to learn the experiments before they are expected to help the students at sites along the river.

6. Allow time for the class to come together and report on and discuss each experiment. Help them understand the relationship of their experiment to the animals and plants that live in and along the river. Ask what the children think the data might be telling them.

7. Examine the other observation sheets at the end of this lesson and discuss them with the children. Emphasize using their senses to help make observations.

Field experiment:
1. Prior to leaving on the field trip, collect all the necessary equipment and organize it according to the experiment in which it will be used. The technician for each of the five groups can be responsible for the equipment, with the assistance of the adult chaperone.

2. While at the field site be sure to have adequate adult supervision (at least one adult for each experiment team.) As even the cleanest-looking water can be contaminated make sure students do not eat anything while they collecting samples and conducting the experiments. Use handiwipes to clean hands after the experiment phase is complete.

3. As each experiment is conducted, be sure that each person records the necessary information on Data Sheet #8. Conduct the experiments at different sites so that results can be compared later.

4. After the experiments have been conducted, students can be given observation sheets to help them further study the site.

5. It is helpful to briefly share and summarize each site, with the help of the students, before they get back on the bus to go to the next site.

6. When the class has returned from the field trip, bring them back together in the next day or two to talk about the data they have collected from the experiments and observations. Compare and contrast results of experiments at different sites and discuss observable differences such as current speed, water temperature and dissolved oxygen levels, etc. Record the results in a variety of ways: on the charts that have been developed in other lessons, on the watershed maps, using the computer to graph and compare data, and through creative interpretation in dioramas, poems, stories, etc.

TEACHER BACKGROUND—WATER AND TEMPERATUE

Background: Air and water temperature are important for the animals and plants living in, or near, the river. Air temperature has mainly a seasonal effect on river water temperature. It may be weeks before a change in air temperature will affect river temperature.

Temperature affects the functioning of living things. When water warms, the temperature inside the so-called "cold-blooded" animals warms. Their metabolism increases, making them breathe faster, and digest food faster. As a rule, for every 10 degrees Celsius in temperature there is a doubling of metabolism. This is true only to a point, however, because high temperatures also decrease the supply of dissolved oxygen in the water. Winter temperatures generally do not get cold enough in the river to affect most fish, but there are some species that can survive in very cold lakes and in the ocean, by manufacturing a type of "anti-freeze" which lowers the freezing point of body fluids.

Air and water temperatures affect plants and many of them die back and become dormant until warmer temperatures come in the spring. Others may die completely, depending upon seeds to reproduce when the temperatures warm.

Temperature is measured both on the Fahrenheit scale and the Celsius or centigrade scale in this country. Our weather is reported in Fahrenheit, but most scientific measurements are measured on the Celsius scale. This makes for some confusion for the students and needs to be explained. The Fahrenheit scale ranges from 32 degrees (freezing point of water at sea level) to 212 degrees (boiling point of water at sea level). The Celsius scale measures the same thing from 0 degrees to 100 degrees. The students can read both scales and record both measurements in their notebooks or data sheets.

Preparation: At this station the students will test water samples of warm and cold water with thermometers that register Celsius and Fahrenheit.

Have at least 2 Celsius Fahrenheit thermometers, 2 containers of water of different temperatures labeled A and B, a sponge to wipe up drips, a data sheets and clipboards, and pencils ready for the group of five students.

Have the students examine the thermometers and talk about the different scales. The words Fahrenheit and Celsius should be written on the board and explained. Be sure that each student gets to do the experiment and record the data.

Discussion: Encourage the students to develop questions that they have about the experimental results. List the questions and lead them to some of the questions they will be considering when they do the field experiment. These are listed at the end of the student experiment on temperature. Use the questions during the follow-up discussions at the end of the field trip.

Student Experiments —Water and Termperature

Overview: In this experiment your team will take the air and water temperatures at your chosen site along the Lamprey River. Temperature is important to living things for many reasons. When the water temperature is warmer, fish move faster and grow faster than when the water is colder. Air temperature is important too. It can cause the water to become colder or warmer. We should remember, however, that air temperature changes much faster than water temperature can. For example, it takes several days or even weeks of warmer air temperatures to make water become warmer.

Focus: What are the air and water temperatures at your chosen site?

Materials:
For the pre-field experiment:
1 Celsius/Fahrenheit thermometer for each member of the team
Cup of warm water
Cup of cold water
Data sheet with clipboard
Pencils

For the field experiment:
1-2 Celsius/Fahrenheit thermometers
Fishing line
Duct tape
Data sheet with clipboard
Pencils
Bucket with a rope attached to the handle

Procedures:
Pre-field experiment:
1. Hold a thermometer in the air until the mercury (the red line) stops moving. Write down both the Celsius and Fahrenheit readings on your data sheet.

2. Hold a thermometer in the cup of warm water until you can take a steady temperature reading. Write down the Celsius and Fahrenheit

readings on your data sheet.

3. Hold the thermometer in the cup of cold water until you can take a steady temperature reading. Write down the Celsius and Fahrenheit readings on your data sheet.

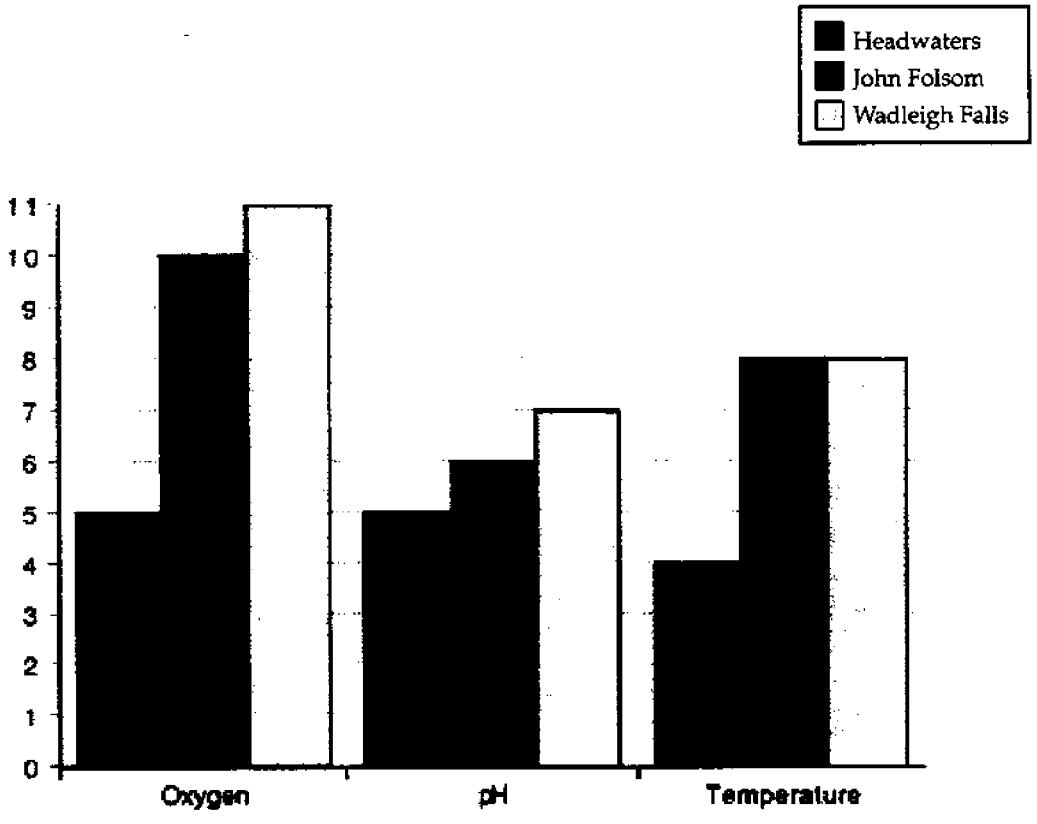
Field experiment:
1. Hold a thermometer in the air until you can take a steady temperature reading. Write down the Celsius and Fahrenheit readings on your data sheet.

2. Get a sample of water in the bucket or put the thermometer directly into the river. Hold a thermometer in the water until you can take a steady temperature reading. Write down the Celsius and Fahrenheit readings on your data sheet.

3. If you want to get a water temperature reading at a deeper spot you can modify your thermometer as follows: cut some fishing line several meters long. About 15 centimeters from the end of the line, tie the line around a small rock or pebble. Wrap a piece of duct tape around the line and rock to hold them in place. Now tie the thermometer to the very end beneath the rock. Secure the thermometer with a piece of tape. Holding the opposite end of the line, carefully cast the thermometer into the water. The rock will act as a weight to keep the thermometer submerged. Keep the thermometer submerged for as long as it took to obtain a steady reading in the shallow water. Write down the Celsius and Fahrenheit readings on your data sheet with a note saying that the temperature was taken at a deeper level.

Discussion:
1. How does air temperature relate to water temperature?
2. Over the course of a day, which do you think varies more?
3. How are water and air temperatures good indicators of the River's ability to sustain life?
4. If you took the temperature of the water at a deeper level, was it different than the temperature at the surface? Why or why not?
5. Do all fish prefer the same water temperature?

Lamprey River Data



Teacher Background—Dissolved Oxygen

Background: Animals in a water environment require oxygen in order to breathe. Some of the free oxygen in the water comes from photosynthesis of plants as they take carbon dioxide out of the water and replace it with oxygen. Most of the free oxygen dissolves into the water from the atmosphere at any point where water interfaces with air. Fish and invertebrates that live in the water breathe by means of gills. The oxygen diffuses into the gills as carbon dioxide and other gases used in their metabolism are expelled. Water contains very little oxygen compared to that in the atmosphere.

In water there are usually less than 12 parts per million parts of water (12/1,000,000) as compared to 21 parts of oxygen per hundred parts of atmosphere (21/100). Fish and other animals that live in the water need at least 4-5 parts of oxygen per million parts of water, or they have difficulty breathing and may suffocate.

Dissolved oxygen rates are much affected by temperature. Cold water with its slow-moving molecules holds more dissolved oxygen than warm water, whose faster-moving molecules push some of the free oxygen atoms into the atmosphere. Waves and fast-flowing waters also create opportunities for oxygen from the atmosphere to dissolve into the water. After the students complete their experiment be sure to discuss how water temperature and the speed of water movement relate to oxygen rates.

Preparation: The test kits all require a water sample of a specified amount and the adding of several chemicals to the sample to allow the free oxygen atoms to be counted. The simplest test kits are the CHEMette kits. You can purchase a CHEMette kit with 100 tests for $40 from CHEMetrics, Inc. The La Motte company has a test that simply requires placing a tablet containing the necessary chemicals in a sample of water, watching the water change color, and comparing the color to a color chart which costs about $20. Either would be easy to use. See the Resource section at the end for addresses.

There are other La Motte or Hach dissolved oxygen kits that contain more detailed work with chemicals, but these are not recommended. If you use either of them, be sure the students have safety glasses on and that they work with protective rubber gloves. They should use the kits only with close adult supervision. Directions for all the tests are in the test kits. They vary according to which test is used.

1. Explain Data Sheet #8 to the students and distribute them with clipboards for use to each group.

2. Have two water samples from different sources available for the students to test in labeled containers.

Discussion:

1. How does oxygen get into the water? (Plants photosynthesize and give off oxygen. This oxygen dissolves in the water. Some mixes in from the air where the water touches air. On windy days, or if the river is moving swiftly over rocks and water falls, even more oxygen mixes in from the air. It would be interesting to do the test in quiet waters at the headwaters of the river and again in swifter flowing water at another location.)

2. Why is dissolved oxygen important to fish and other animals that live in the water? (They must breathe oxygen, just like most other animals. Fish must have at 4-5 parts of oxygen per million parts of water, or they suffocate.)

3. Does temperature of the water affect the amount of oxygen in the water? (Yes, the colder the water, the slower the water molecules move, so the more free oxygen is able to stay in the water. As the temperature rises, water molecules move faster and bump some free oxygen atoms into the atmosphere.)

Student Experiments—Dissolved Oxygen Team

Overview: In this experiment your team will measure the amount of dissolved oxygen at your selected river location and learn what the measurement indicates about your site. Animals living in the water depend upon the dissolved oxygen to breathe. For example, fish must have 4 to 5 parts of oxygen per million parts of water or they suffocate. You will be measuring free oxygen that is dissolved in the water and available for animals to breathe. Eight to ten parts of oxygen per million parts of water is a lot of oxygen and means that the river is a healthy place for fish, mussels, and other water animals to live.

Focus: How much oxygen is dissolved in the water at your river site? Is this site a good place for fish to live in?

Materials:
Test kit or ph test tape and colorimeter
Two containers,
Water from two different sources
Pencil
Data sheet and clipboard

Procedure:
Pre-field experiment:
1. Your teacher has set up two labeled water samples from different sources in small buckets about 1/2 full.

2. The temperature group will take the temperature of each sample, record it and tell you what it is. Write them in on the chart that the teacher will provide for you on your data sheet.

3. Now follow the directions for using the dissolved oxygen kit to determine how much oxygen is in each water sample.

4. Record the amount of dissolved oxygen on your data sheet. Could a fish live in these waters? Why or why not?

Field experiment:
1. Collect a sample of water from your river location in the bucket. Fill the bucket about 2/3 full.

2. Submerge the small bottle from the CHEMette kit and fill it to the top line.

3. Put a vial containing the indicator chemical into the bottle, press down hard and break the tip of the vial.

4. Watch the water come into the vial and mix with the indicator chemical.

5. Leave the vial in for about 2 minutes and watch the color change from clear to blue.

6. When the color stops changing, place the vial into the comparator and compare colors to find the amount of oxygen in the water. Look at the number next to the color of the vial containing your sample. This is the number of oxygen atoms that are in each million molecules of water.

7. Write down the amount of oxygen on your data sheet. Oxygen is measured in parts per million (ppm).

Discussion:
1. We have much more oxygen in the atmosphere to breathe than fish have in water. We have about 21 parts per hundred and they have only a few parts per million. How can they live with so little oxygen?

2. Was the river the same temperature at each site that you measured? Were the dissolved oxygen levels the same at each site that you measured?

3. Does cold water hold more oxygen than warmer water? Why?

4. Most trout prefer to live in colder waters. What might be one reason for this? (Clue: Does your experiment help you answer this question?)

Teacher Background—Current Speed

Background: Currents in bodies of water are very important for moving food, oxygen, and microscopic plants and animals about. Currents help determine where water animals and plants live. In Betty's Meadows at the Headwaters of the Lamprey River, the river is dammed and really doesn't have much of a current. Plants with shallow root systems, such as water lilies, live there. Beavers and muskrats build their lodges there. Ducks nest near the water in grassy areas. In the river where the current is fast, plants with longer roots and flexible bodies are found. Fish swim at ease here and some build nests in gravel areas, where the current is swift and oxygen is plentiful, to deposit their eggs. Waste products are broken down and swept away by the current, redistributing them as food for filter feeders like fresh water mussels.

At this station students will calculate speed or rate of the current at two sites, dividing the distance water flows (20 meters) by the time it takes to do it. Rate = distance / time.

Preparation: Have the students mark a 20-meter rope in meters and use it both in the classroom as a measuring device for the pre-field and field experiments. They will also need several oranges to float in the river and a volleyball or basketball to use in the pre-field experiment.

Discussion:
1. How do currents affect animals?
2. What adaptations do plants have to help them live in strong currents?
3. How do you determine the rate of speed of a current? What is a current?

Student Experiments—Current Speed

Current Team: **How fast is the river flowing?**

Overview: In this experiment your team will calculate the current speed , or how fast the water in the Lamprey River is flowing. Scientists are interested in current speed because it helps to determine what kinds of plants and animals can live there. If the water is moving fast, plants must have a strong root system and leaves that let the water pass over or through them. Animals that need a lot of oxygen and can swim, burrow in the bottom or hang onto a rock prefer to live here also. If the water is moving slowly, floating plants with large leaves and a weak root system can live there easily.

Focus: What is the current speed at sites along the Lamprey River and how does it affect animals and plants there. (Try a place where the river moves slowly and one where it is moving faster.)

Materials:
Pre-field experiment:
Meter stick
Chalk or masking tape
4 balls (basketball or volleyball)
Stopwatch
Data sheet and clipboard or science journals
Pencils

Field experiment:
20-meter rope marked in meters
Stopwatch
8 items that will float (oranges, paper boats made by students, balls,
Data sheet and clipboards or science journals
Pencils

Procedure:
Pre-field experiment:
1. In the classroom or another large area such as the gym or hallway, measure a distance of meters on the floor with a meter stick. Use chalk or

masking tape to mark the beginning (A) and the end (B) of the 20 meters. Explain that the team will use the ball to represent the current of a river.

2. Have one team member start the ball rolling along an imaginary line making sure the ball is rolling as it passes A and after passing B.

3. As the ball rolls past A the team member at A should shout out "Start!"

4. A fourth team member holds a stopwatch and starts timing as the ball passes A.

5. As the ball rolls past Point B the team member at Point B shouts out "Stop."

6. The timer stops the timing and announces to the team the number of seconds the ball took to pass from A to B.

7. Team members write down the amount of time recorded in their science journals.

8. Repeat the first seven steps 4 times, rotating duties among team members.

9. Calculate the speed of the ball from Point A to Point B in centimeters per second using the following formula for each time the experiment was conducted: Current rate (Speed) = Distance divided by Time.

10. Calculate the average speed of the ball. The average speed is the sum of all recorded speeds divided by the number of times the speeds were recorded. Why did we do the experiment several times and average the results?

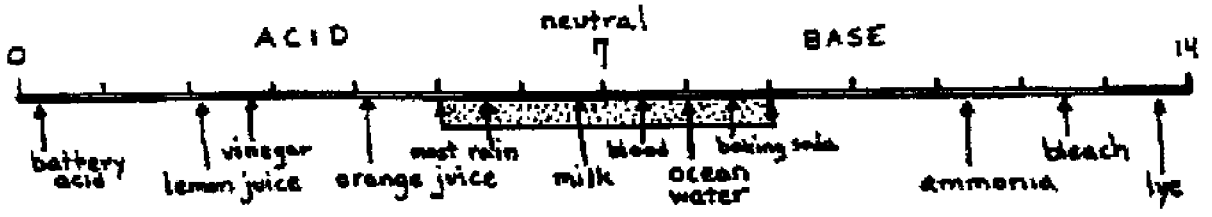
Field experiment:

1. Determine which way the river is flowing. Now designate the upstream end of the 20 meters as Point A and the downstream end as Point B. Have one team member stand along the bank at Point A and one at Point B. Follow the steps in the pre-field experiment. Repeat twice or more and average the results.

Teacher Background—pH: Acidic or Basic

Background: The pH scale runs from 0 to 14, with 7 as neutral between acidic and basic substances. Plants do well in slightly basic water (between 7 and 8 on the scale). Water animals and most plants cannot live in water that is 5 or less (very acidic) on the scale. The scale increases by powers of 10 moving from number to number.

pH Scale



At this station students will measure whether water at each location is acidic or basic (alkaline) or neutral and learn what that indicates about the water. Ordinary rainwater usually has an acidity of about 5.6. Acid rain is usually below 5.0. Sulfur dioxide and nitrogen dioxide (byproducts from burning of fossil fuels), react with water and atmospheric oxygen to produce sulfuric and nitric acid. Hundreds of lakes in North America and Scandinavia have become so acidic (below 5 on the scale) that they no longer can support fish life. In North America, 50 percent of the high mountain lakes in the Adirondacks no longer have fish because of high acidity. *(Vesilind and Pierce, Environmental Pollution and Control.)*

Preparation: Obtain a wide-ranging pH kit—one that shows all 14 levels of pH. These are available from the LaMotte Company for about $30. Some high or middle schools have these kits and will loan them to you for limited use.

Procedure:

1. Prepare four "mystery substances," each placed in its own jar. Make the jars "A", "B", "C", and "D" and make a list of what is in each jar. The substances should be rainwater, tap water with lemon juice, ammonia, and white vinegar. Each substance should be as transparent as possible.

2. Discuss what the substances might be with the students. Can they tell by looking? How else can they find out? Be sure they understand that tasting an unknown liquid is not safe. Tell the students that we have other techniques. One is to use an **indicator**—something that has been pre-tested with a variety of liquids to determine a scale of measures that we can use with unknown substances. There is an experiment in most elementary science texts showing how to boil red cabbage in water and use the water as an indicator of acids and base liquids. This will aid in understanding what an indicator is.

Student Experiments—pH TEAM

Overview: In this experiment your team will measure whether water in the river is acidic, basic (alkaline), or neutral and learn what that indicates about the water. The most common way to determine this is to measure the concentration of hydrogen ions in the water, which is the water's pH. Tthe term "pH" comes from combining the letter "p" from the German word "potenz" meaning "power" with H, the chemical symbol for hydrogen.) Changes in pH values of water are important to the health of many organisms. Fish and most plants need to live in water that is between 5 and 7 on the pH scale. Can fish live in this river? Can plants live here?

Focus: What is the pH of the water at your sites? How does the pH affect plants and animals who live there?

Materials:

Pre-field trip:

Wide-range pH kit (available from science supply stores)
Four "mystery substances" prepared by your teacher in advance, in jars labeled A, B, C, D
Science journals with A, B, C, D, listed
Pencils

Field trip:

pH kits (available form science supply stores)
One clean baby-food jar per team member
Diagram showing pH ranges that can support life
Data sheets and clipboards
Pencils

Procedures:

Pre-field experiment:

1. Look at the mystery substance A. List "A" in your science journal and what you observe about it. Does its appearance (color, thickness, etc.) help you determine what it is?

2. Open the jar. Then, holding the jar away from your face, wave your hand over the top of the jar toward your nose a few times. Sniff the air. DO NOT STICK YOU NOSE OVER THE JAR AND SNIFF DIRECTLY! Does the odor help you determine what it is?

3. Test the substance using your pH kit. Is the substance acidic or basic? Write the pH number down in your science journal next to the letter A. Does this information help you identify the substance?

4. Repeat steps 1 - 3 to test the other "mystery substances."

5. Once you have completed the testing of each substance and recorded your findings in your science journal, guess what the four substances might be. Check with your teacher to see if you are correct. Record this information next to the pH readings in your journal.

Field experiment:
1. Collect a sample of water from your chosen sites along the river.

2. Test the pH of the sample immediately after collecting it, according to the directions in your kit. (Changes of several degrees in temperature can change the reading a bit.)

3. Record the pH value on your data sheet. How does this sample's reading compare to those of the mystery samples that you tested in class? Which of the mystery sample readings is it most like? Is this a good site for fish and for plants? Why?

Discussion:
1. What was the pH of the rainwater you measured at the pre-field station and the river water at your field site?

2. Are they the same or different? Why? What could make the pH of rainwater differ from the pH of the water at your river site?

Teacher Background—Water Transparency

Background: Transparency of the water determines how far light will penetrate into the water and therefore the area where the microscopic plants that are the basis of the food chain can occur. Turbidity refers to whatever tends to cloud the water and cut off light. This can be microscopic animals and plants, eroded soil and suspended sediments and chemicals, and even physical effects such as wind riffling the surface of the water. At this station students will measure transparency and observe whether transparency of water affects two contrasting locations. Note: It may be difficult to do this test if there is much current in the location you choose. The secchi disk (sek-ki) is a round black and white disk 6 to 8 inches in diameter that is weighted and attached to a rope, market in centimeters or meters. It is lowered into the water until it disappears from sight. Then it is brought back to where it is just barely visible, and as it is withdrawn depth of the light zone is determined by counting the centimeters or meters on the rope. The students will make secchi disks in class.

Preparation: Have the items listed on the Student Experiment sheet available and build the secchi disks as a class or team activity.

Discussion questions:
1. Why is transparency of the water important to plants and animals?

2. What might be in the water that cuts down on transparency?

Student Experiments—Transparency Testing Team

Overview: In this experiment your team will measure the transparency of the water at your river sites. The clearer the appearance of the water the more transparent it is, and the more light is available for water plants to use to make food. Many small animals eat these microscopic plants called phytoplankton, and are then eaten themselves, by larger animals. Phytoplankton is the basis of a food chain that often includes us. Many things can cut down on transparency and make the water **turbid**. Can you think of some? You will use a Secchi disk to measure transparency. A Secchi disk is a scientific tool for measuring relative clarity of deep water.

Focus: How far does light penetrate into the water at your chosen site?

Materials:

Pre-field experiment:

Large plastic can lid, white or light-colored, 20 centimeters (about 8 inches) in diameter
One black waterproof marker
10 meters of 1/4" rope (a thin clothesline rope)
A 2# fishing weight
Strips of colored ribbon
Eyebolt with 2 nuts and washers
Several sharpened pencils
Data sheet and clipboards or science journals
Pencils
Meter stick
Ruler (marked with centimeters)

For the field experiment:

Secchi disk (constructed from the materials above)
Data sheet and clipboards or science journals
Pencils

Procedures:

Pre-field experiment

Before you can measure the transparency of the water at your river location, you need to construct a Secchi disk. (If the disk has already been constructed you should go to step 6 and read how the Secchi disk will be used.)

1. Use your ruler to find the center of the plastic lid. Measure across the lid until you find the widest point from one side to another. Draw a line. Then turn the lid so that the line is straight up and down. Draw a line across the widest point again. Now your lid is divided into quarters.

2. Use the waterproof marker to divide the top (outside) of the lid into quarters. Color the upper left and lower right sections black.

3. Use a sharpened pencil or a ballpoint pen to punch a hole in the middle of the lid.

4. Thread a nut and washer (in that order) onto the eyebolt.

5. With the nut and washer on the eyebolt, insert the eyebolt through the center of the lid. Then add the other washer and nut (in that order) to the eyebolt on the underside of the lid.

6. Use duct tape to attach the fishing weight to the bottom of the lid so that the lid will hang straight, horizontally. (This takes some trial and error experimenting.)

7. Tie one end of the rope to the eye of the eyebolt.

8. Using the meter stick, measure from the eyebolt 250 centimeters (about 10 inches) along the line, and tightly tie a ribbon around the line. Continue tying ribbons to the line every 250 centimeters. In the field, you'll lower the Secchi disk into the water. As soon as you con no longer see it, you'll stop and calculate the number of ribbons submerged to determine the transparency of the water.

Field Experiment:
1. If possible, stand on a bridge over the water at your River location. If there is no bridge, simply use the bank. Lower the Secchi disk into the water just to the point where you can no longer see it.

2. When you can no longer see the Secchi disk count the number of ribbons remaining above the surface of the water. Subtract the number from the total number of ribbons on the line to calculate the number of ribbons submerged with the disk. This is the distance light travels through the water and provides your transparency reading.

EXAMPLE: Suppose you count 10 ribbons above the water at the time you can no longer see your Secchi disk. If your rope had a total of 15 ribbons, you would subtract 10 from 15, and your turbidity reading would be 5. If your Secchi disk reaches the bottom and you can still see it, you should still record the number of ribbons submerged with the disk. If you can still see the disk after it has reached the bottom, what do you think it means?

3. Repeat the procedure once or twice at different sites along your location recording the transparency each time. To get an average of your readings, add the transparency readings and divide by the number of times you performed the test. Record the average turbidity reading in your science journal.

Discussion:
1. What do your transparency readings tell you about the water at your site?

2. How does light affect life in the water?

Data Sheet #1: What is the river like at this location?

Site _____

Your name_____ Date _____

Describe the following:

Movement of the river _____

Width of the river_____

Color of the water _____

Sounds the river makes_____

Smells you notice _____

Is the river deep or shallow? _____

How the river bed looks ___sandy ___muddy ___rocky ___other

(If you checked "other,"explain:)_____

Landforms surrounding the water: ___mountains ___ hills
___flatland ___marshland ___forest ___fields
___other? _____

Man-made structures _____

Comments _____

_____

Data Sheet #2: What changes can you find at this location?

Site _____

Your name_____ Date _____

Describe the following:

The animal life you see in the water _____

_____

The animal life you see near the water _____

Things that have been changed by weather (floods or ice), animals (beavers, muskrats, mice, woodpeckers), or man (fire, trails, gardens, trees planted or cut)

weather _____

animals _____

people _____

signs of pollution _____

_____

Comments _____

Your group may collect a sample of leaves, rocks, and soil from each stop on the field trip. Take only one of each item sampled and use one bag for each site. Use the plastic jar to take a water sample for viewing later with microscopes. Remember to label the bag and jar with your name, date, and the site.

Data Sheet #3: Draw this site in the space below.

Site _____

Your name_____ Date _____

Data Sheet #4: What animals live at this site?

Site _____

Your name _____ **Date** _____

What animals can you hear? _____

What animals can you see? _____

Be a detective! Find signs that prove animals live here. Describe where you found each one. Look for:

Nests _____

Webs _____

Cocoons _____

Burrows _____

Tree holes _____

Other marks on trees _____

Trees cut by beavers _____

Droppings _____

Tracks (what kind?) _____

Other _____

What animals probably live here? _____

_____

Data Sheet #5: What trees can you find here?

Site _____

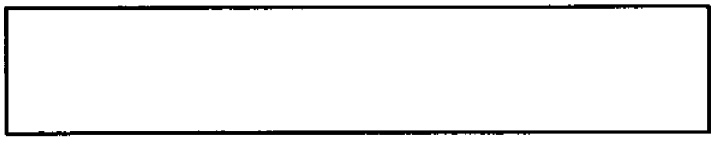
Your name_____ **Date** _____

Go to the wooded area and stay there to observe the different kinds of trees. Use a tree guidebook or adult to help you. List three trees that you can identify, draw the pattern of their bark and make a sketch of each tree.

1. _____

2. _____

3. _____



What kind of tree is the most common here? _____

Are the trees different heights? _____ Why or why not? _____

_____

Has anything damaged trees that grow here? What? How can you tell?

_____

Collect one of each different kind of leaf from the ground. Put the samples from one site in a ziploc bag and label with your name, date and site.

Data Sheet #6: What are some of the small plants at this site?

Site _____

Your name_____ **Date** _____

Choose a sunny spot and a shady area, and spend time there looking at some small plants that grow there. Use the wildflower and pod guides to help you identify them. Choose your favorite plant from each location and sketch it. Remember to write in the color and whether it has an odor.

1. Plant growing in the sun

2. Plant growing in the shade

How are the plants different?_____

How are they alike? _____

Which one is bigger? _____

What kind of soil are they growing in? Sunny plant _____

Shady plant _____

Your group may collect the plant if there are at least 20 of the same kind in the area. You may collect pod samples or seed samples if there are any. Store them in a small ziploc bag with your name, date and site.

Data Sheet #7: What fungi can you find at this site?

Site _____

Your name_____ Date _____

Go to a damp shady site and look for fungi. Fungi can also grow on the trunks of trees. Try to find as many different types of fungi as you can. Describe at least one and draw a picture of it. Don't forget to write down its color.

Data Sheet #8: What were the results of your experiments?

Site _____

Your name_____ **Date** _____

List data from your experiment here. Collect data from the other groups and fill in the rest of your data sheet.

1. TEMPERATURE TEAM. List air and water temperatures in Fahrenheit and Celsius.

	Fahrenheit	Celsius
Air		
Water		

2. DISSOLVED OXYGEN TEAM. Remember the colder the water is, the more free oxygen it holds.

Dissolved oxygen is _____parts per million (ppm)

3. pH TEAM. Is the Lamprey acidic or basic? _____

The pH reading at this site was _____

4. CURRENT TEAM. Remember that the distance and the time it takes your floating object to travel can help you find the rate or speed at which the current is moving. Distance divided by time equals the speed of the current. Your distance is 20 meters which is the length of the rope.

Distance	Time	Current meters/sec.

The average speed of the current at this site is_____

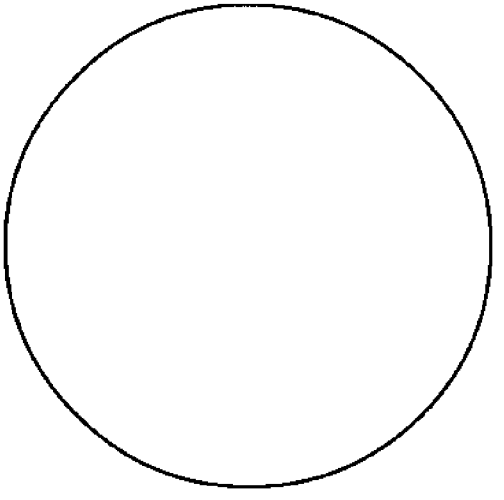
5. WATER TRANSPARENCY TEAM.

Light can penetrate _____ centimeters into the water at this site.

Data Sheet #9 What can you see in your water sample?

Site _____

Your name_____ Date _____



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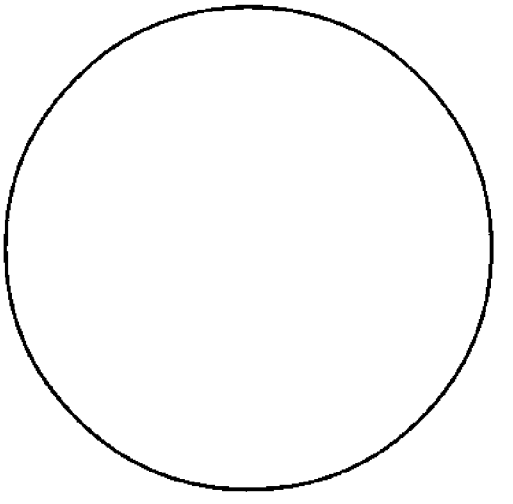

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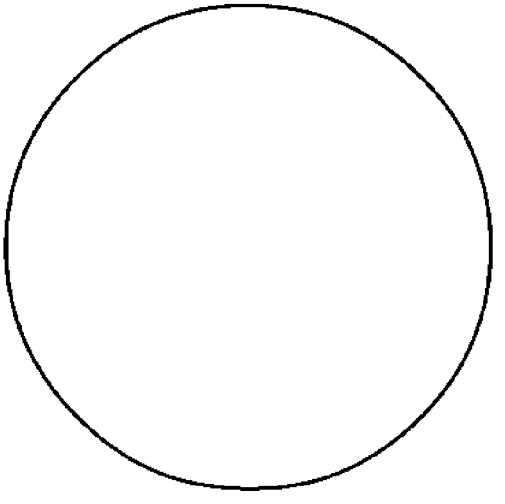

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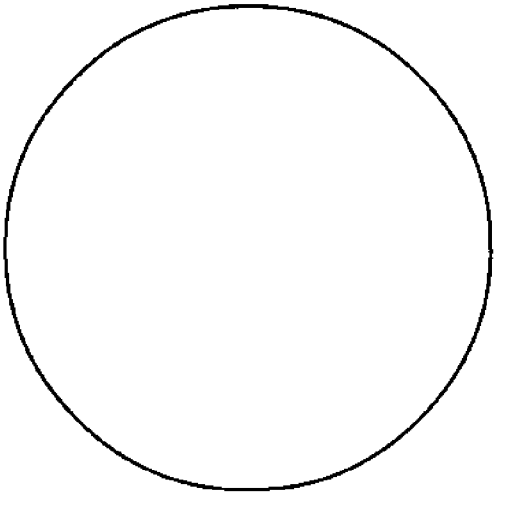

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Lesson 5

People of the River

Overview: In this lesson your students will learn about the people who have lived along the Lamprey River in the past. They may have lived at any time between 1600 and the mid-1900's. There are more than 20 profiles of these people from Lamprey River communities following this lesson. Their stories give us a glimpse of life along the river during another time.

Focus: Who lived along the Lamprey, and how did the Lamprey influence their lives?

Duration: several hours

Materials:
____Multiple copies of "People of the River" profiles at the end of this lesson
____Other resources about New Hampshire history
____Street maps of communities along the river
____Poster board, construction paper, markers, glue, paint, brushes (whatever the students need for their projects)

Procedure:
1. Find out what your students already know about the people who have lived along the river. Encourage the children to ask their parents and grandparents about people from their families who may have lived near the river in the past. Look at street maps of communities along the river. How many streets are named after people. What are those names? When did they live? What were their occupations? How did they use the river?

2. Encourage the children to read several of the profiles. Have each student select his or her favorite. Ask them to read it, think about the information, and then tell a partner about the article.

3. Have the student take notes from the article. Ask them to think about the following questions. What are the important facts about this person? When and where did the person live? What do you think the person looked like? What did he or she do for work? What is special and fascinating about this person's story? They may use the "People of the River" note-taking guide or record their information in their journals.

4. Now your students should plan their posters, or similar projects. Questions for them to ask themselves are: What should the title be? What information should be on the poster? Do I need other resources? Do I need maps? Where can I get more information?

5. After they have gathered their information, brainstorm with your students about how to make their poster attractive. Written information should be clear and neat. Have them gather pictures, make photocopies, or draw pictures for their poster. They may type written information they plan to include in their poster.

6. Help the students decide when they are ready to create their posters or projects and give them time to complete them.

7. After the posters are completed, students should work on their class presentations. They may work alone or with a partner. A short role-playing session illustrating good presentation skills would be helpful. In discussion with the class, draw up a list of criteria for good presentations. Use this as a guide and an evaluation tool when the presentations are given.

8. After the students give a presentation, the other members of the class might write a few sentences or make a small drawing about the person being described in their journals.

9. Encourage your students to find ways to connect the information from the articles to the large map created in Lesson 3.

Other ways your class might use the profiles:
1. Create a time line, then add names, dates, and pictures generated from the information in the articles.

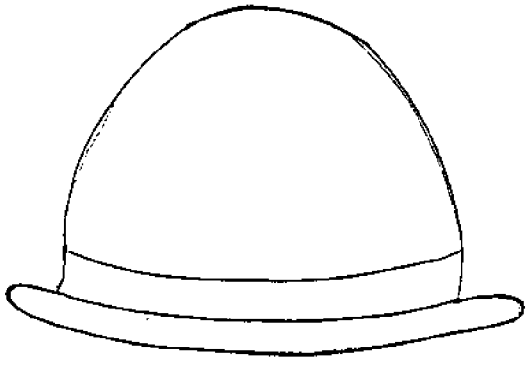
2. Dress up as "river people," and then give oral presentations or create a play.

3. Gather or make props that relate to the information in the articles, then give oral reports that incorporate the props.

4. Make advertisements for or about the people in the articles.

5. Draw profiles of human heads. Make hats that might have been worn by the river people. Attach cards that give interesting information about the person to the profiles.

6. Write ads for workers in the various jobs represented by the People of the River profiles. Publish a classified section of a newspaper, using the ads, or design them as posters.



"People of the River" Note-taking Guide

What was the person's name? _____

When did the person live? _____

Where did the person live? _____

What did the person do for work? _____

_____

How was the person connected to the river _____

_____

What were some interesting facts about the person? _____

_____

_____

What other information did you learn about the person? _____

_____

_____

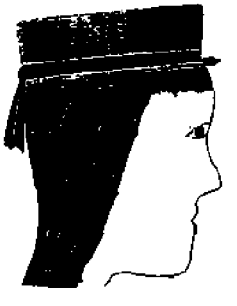
Imagine how the person looked and write a short description. _____

_____

_____

_____

Matt H.



Shelby C.

Native Americans—People of the Dawn

Archeologists have studied several sites on the Lamprey River. They found tools, arrowheads, pieces of pottery and bones. When they tested these **artifacts**, the results proved that Native Americans lived along the Lamprey River 8000 to 9000 years ago and continued to live there until the 1700s. The Native Americans in the area were probably part of the Piscataqua or Squamscot tribes. They called themselves the Abenaki or People of the Dawn and belonged to the larger Algonquin group.

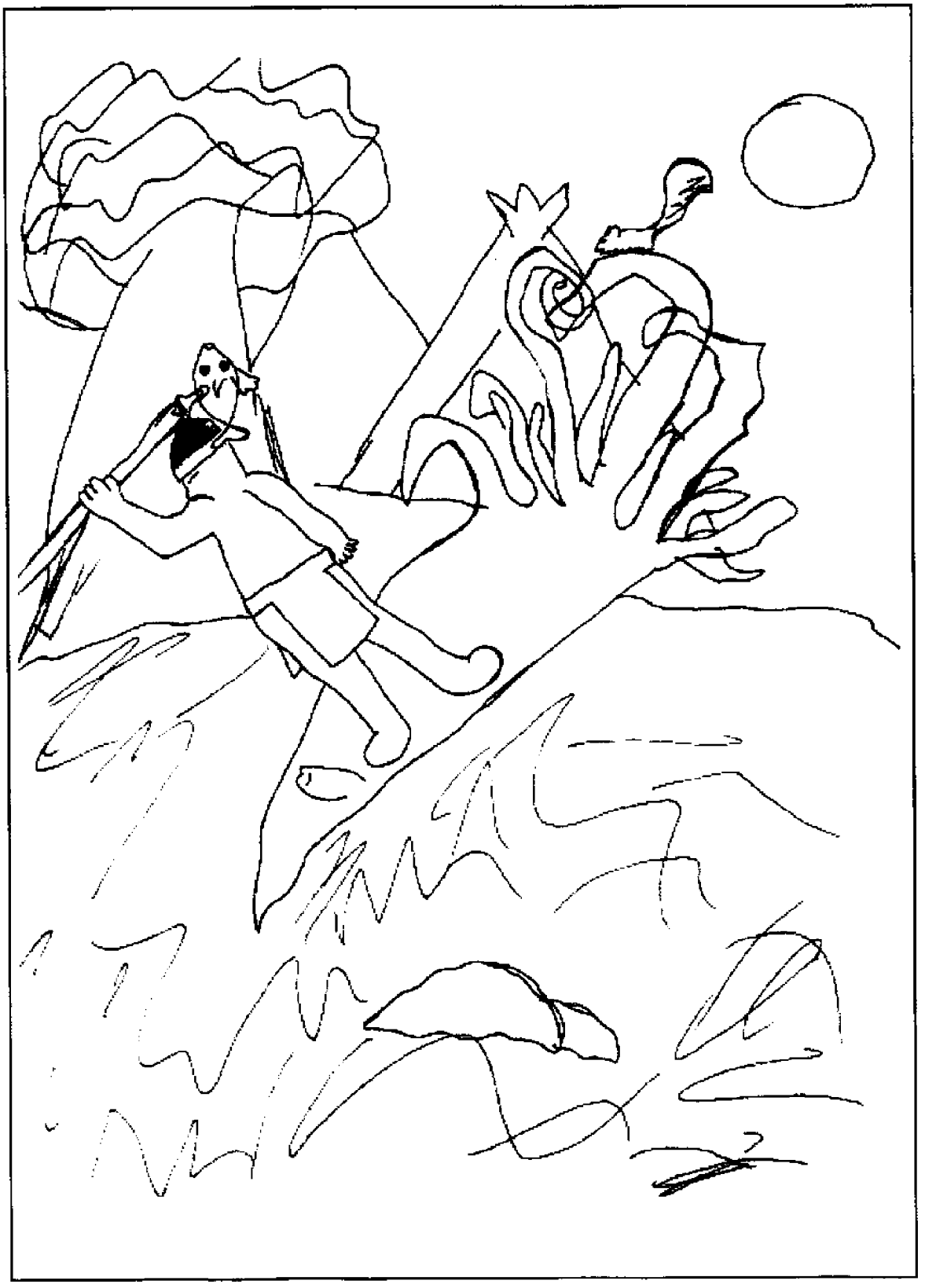
These native people set up their summer camps at spots that were convenient for fishing, farming, or finding materials for clothing, shelter or food. One site might be near clay banks of the river where they could use the clay to make simple dishes. Another campsite might be near a stone quarry where they could get stone to make tools and arrowheads. A third site could be near the marsh grasses whose seeds they gathered for food. Or they might camp on the shores of Great Bay where they could harvest oysters and clams. We know they lived and fished on an island in the river at Wadleigh Falls in Lee.

The "people of the dawn" continued to live near the river after the European settlers began arriving in 1623. They were peaceful and traded furs for cloth, blankets, pots and knives. The settlers learned many valuable things from the Abenaki people, such as what plants could be used as medicines, and how to make snow shoes.

Wadononamin, **sagamore** or chief of the Piscataqua tribes, granted the land between two branches of the Lamprey River to Edward Hilton, Jr., on January 17, 1660. Edward Hilton, Jr., was the oldest son of Edward Hilton, one of the first settlers of Dover. The native people called this place Washucke. It was agreed that Wadononamin could use the Washucke planting ground during his lifetime.

Many Native Americans left the area in 1672 and moved to the Hudson River near Troy, New York. This happened before King Philip's War in 1675, the first of the great New England Indian Wars. Do you think they knew there was going to be a war? Is that why they moved? What might have been other reasons?

Picture of Indian spearing fish



The Freese Family

Deerfield

In the early 1700's, Jacob Freese, a resident of Epping, bought 150 acres of land in what was to become the town of Deerfield in 1763. At the time, Deerfield was known as **Range** 5. He added 40 more acres in 1768. The Lamprey River flows across this property near where Deerfield Elementary School is now.

Jacob never lived on this land, but he and his sons developed the mill site on the river. A dam, which is still standing, was built and created Freese's Pond. In 1773, Jacob's son Andrew made his home near the millpond. By 1780, the family had built a house, barn, and other smaller buildings on their property. They also owned half interest in the sawmill and **gristmill** (for grinding grain into flour) near the dam.

Farmers did many different kinds of work during the year. Andrew Freese cut and hauled logs to the millpond during the winter. Sleds pulled by horses carried the logs across the snow. When the millpond thawed in the spring and flowing water once again turned the mill wheels, the logs were sawed into lumber. The farmers then hauled their lumber by horse and wagon to their homes, where they used it to improve or repair their farms. They might also sell the lumber in order to buy supplies. During the spring and summer the farmers worked on their farms, raising crops and tending their animals. In the fall, the grain they harvested from their fields was hauled to the gristmill where it was ground into flour. Soon it would be winter and they would be cutting timber once again.

Andrew's sons, Dudley and Jacob, continued to live on the farm and run the mill. Jacob built a second home on the property. This land stayed in the family for nearly 200 years, but by 1904 the mill wheels were no longer turning, and the old mill was falling down. The Freese and Robinson families continued to maintain the dam. The original home site was sold in 1928. The rest of the property, the pond and the dam were sold in 1970.

Lone Tree Boy Scout Camp — Deerfield

For 8,000 years, people have camped along the river; first the Native Americans, then colonists, and finally scouts and other recreational groups. Have you ever camped along the Lamprey?

The Lone Tree Boy Scout Council of Amesbury, Massachusetts, wanted to build a summer camp for their scouts. Their search led them to Deerfield, New Hampshire. There they found a good site for a camp on Freese's Pond. Freese's Pond was really a millpond, which was created when a dam was built across the Lamprey River. This property was owned by Jenny Freese. In 1928 the council bought 150 acres from Jenny and began transforming the Freese farm into a summer camp for boys.

The Council created a waterfront by adding docks, floats and a diving board. They were given permission to **dredge** the pond or add height to the dam in order to make the water deep enough for diving. Soon they had a swimming and boating area for the scouts to enjoy.

Most of the Freese farm buildings were turned into camp buildings. The house became a store and post office. Then the barn, with the addition of a wood floor, screens and kitchen, became the **mess hall**. It could serve 100 boys. A large stone fireplace was built at one end of the barn. The carriage house became the craft workshop and the shoemaker's shop became the camp's **infirmary**. Across the road, volunteers built cabins and tent platforms where the boys would sleep.

The camp was dedicated in 1929 and was still operating in 1937. By 1943 the property had been sold and the camp was no more. Some think the camp was sold for fear of polio being spread by swimming in fresh water.

VALENTINE HILL — Durham

Valentine Hill was one of the early settlers of Durham. He was from England and had a brother who lived in London. By 1636 he had sailed to America and was living in Boston where he was a **proprietor**, the deacon of a church, a member of the Ancient and Honorable Artillery Company, and part owner of a wharf.

In 1643 Valentine received a **grant** of land on the Oyster River. His second land grant was at Wheelwright Pond. He raised cattle on this property. Both of these grants were in the town of Dover, because Lee and Durham weren't towns yet.

In 1649, Valentine and William Beard got permission to build the first sawmill at the falls on Oyster River. At that time mills used flowing water to turn water wheels. The water wheel turned gears that moved the saw up and down. When a log was pushed toward the saw, the saw blade moving up and down cut it into flat boards.

Valentine built a house near his mill, then received another 500 acres for a farm on the north side of the Oyster River. This property included all the land that eventually became the village of Durham.

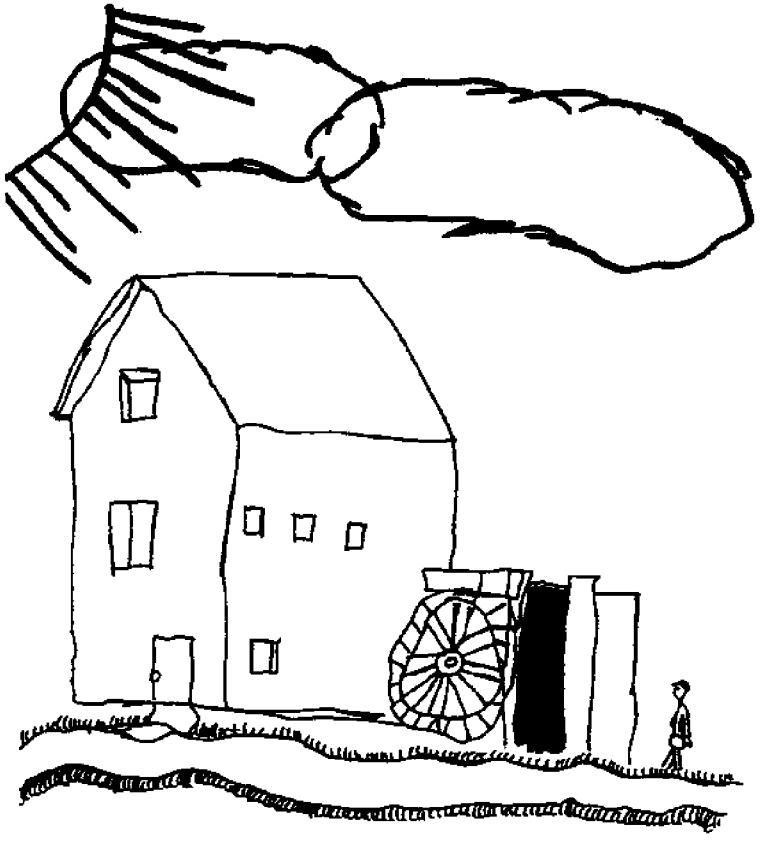
In 1652, he was given permission to build mills on the Lamprey River, too. He was also allowed to cut the timber along the river. His **timber rights** extended a mile into the woods.

Valentine's mill on the Oyster River often couldn't operate in the summer and fall because there wasn't enough water flowing over the falls to turn the wheel. Of course, it all depended on the amount of rainfall the area had received. He looked for ways to increase his waterpower and decided to build a canal from the Lamprey River to his mill. This would direct some of the water from the Lamprey River into the Oyster River. When he got permission to build the canal in 1655, it was probably the first canal project in New England.

Valentine's canal was to begin at the Moat, an island in the Lamprey River that is near Packer's Falls, connect with Denbow's Brook, and flow into the Mill Pond above Oyster River Falls. Longmarsh Brook could be this canal. However, no one is sure if Valentine ever completed the canal.

Valentine employed many men at his farms and mills. Some of them were Scots who were taken prisoner by the British. The prisoners were marched to Durham and Newcastle in England and many were shipped to Boston on the ships Unity, John and Sara. In Boston they were sold for 20 pounds each. They had to work from 5 to 7 years to pay for their passage and to learn a trade. At the end of that time, they were **freemen**. They couldn't marry until they were free. These men worked in shifts at Valentine's mills and had three days a week to work in their own gardens. Patrick Jameson and Thomas Doughty were both Scots who were **indentured** to Valentine Hill.

In 1655 Valentine built the first **meetinghouse** in Durham. He was selectman from 1651 to 1657 and a judge from 1652 till his death in 1661. His first wife was Frances Freestone who died in 1644. His second wife was Mary Eaton.



Cailin B.

Moharimet was a Native American chief or **sagamore** of this region in the seventeenth century. Many old records, such as wills and deeds, mention Moharimet's "planting ground," Moharimet's Marsh, and Moharimet's Hill as landmarks when describing the location of land. For instance, in 1656 Charles Adams had a **grant** of 100 acres of land at the foot of Moharimet's Hill. The name "Moharimet" is still used today and is the name of an elementary school in the Oyster River school district.

Moharimet's "planting ground" where his people planted squash, beans and corn was along the Lamprey River in Durham. Moharimet's Marsh was near the "planting ground." Moharimet's Hill was in Madbury. According to legend, Moharimet lived on this hill. It is also said there is a "Council Rock," a large boulder where he made peace with the settlers. It was the meeting place of his tribes.

Moharimet was present when Samuel Symonds of Ipswich, Massachusetts bay colony, received a land grant from the King of England of 640 acres and water power rights on the Lamprey River. His **water power rights** were at Wadleigh Falls in Lee, which at that time was part of Dover.

What do you think Moharimet was like? Do you think he realized he was agreeing to his land being owned by someone else? Did Native Americans think that anyone could own the land?

INA THOMPSON — Durham

The following information is from a paper written by Ina Thompson called "The Lamprey River." Excerpts from this article appeared in The Transcript on August 1, 1978. The title was "Lamprey River: A Place For Fun." It's about Ina's memories of the Lamprey River and life at Highland House. Highland House was an inn operated by the Thompson family. It still stands on Bennett Road in Durham.

Part 1: Ice Houses

Highland House had its own ice house. Neighbors got together in February to cut ice from the river. After the snow was shoveled off the river, someone used an ice saw to cut the ice. Cutting the first piece was the hardest part. You used sturdy tongs to move the ice, but you had to be careful not to fall in.

According to Ina Thompson, "A team of horses fell in one time, and another team pulled them out. My dog fell in and was gotten out by the men, then raced to the house to be rubbed down and dried by the kitchen range."

After several pieces of ice were cut, they were hauled to the ice house on a sled. The blocks of ice were arranged in the ice house, then sawdust was placed between each layer. This process continued until the ice house was full. It worked so well that the ice didn't melt for a whole year.

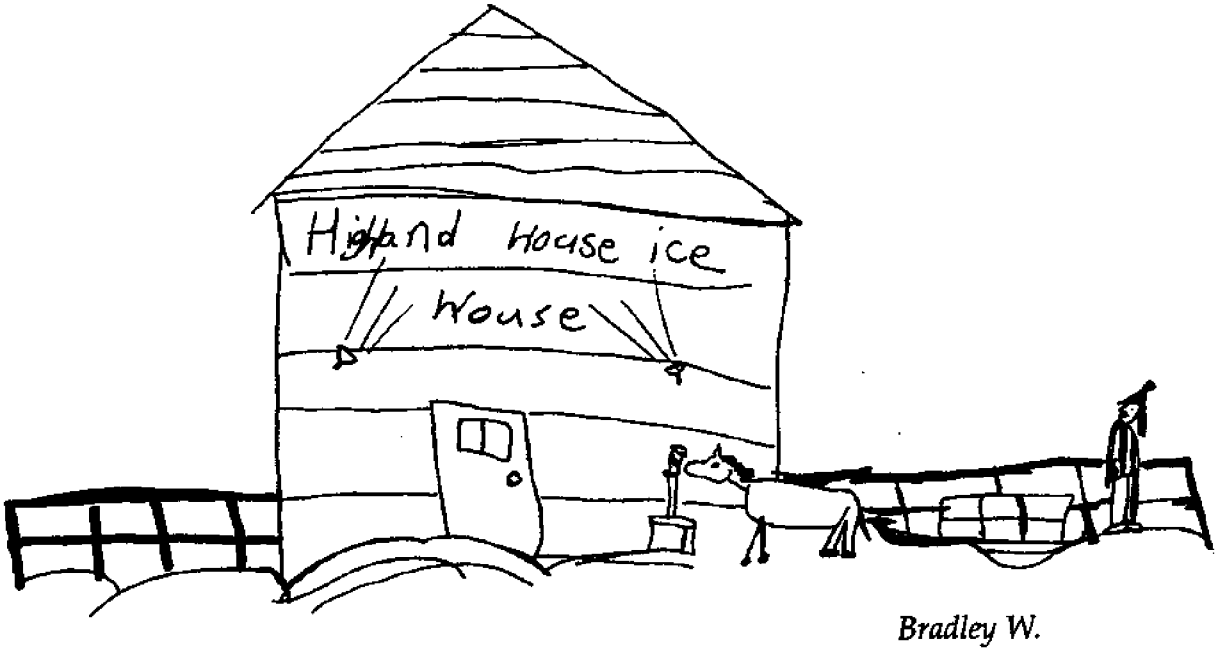
Mr. Fillion of Newmarket filled his ice house, which was at the river's edge, each winter. Then in the summer the ice was taken by horse and wagon and sold to homes and businesses in the area. The crystal clear ice cakes were used in refrigerators or ice boxes. "Highland House has a walk-in ice refrigerator used in the olden days for sides of beef, lamb, pork and veal," said Ina Thompson.

Turcotte's Hardware store in Newmarket had an ice house in the back. The Star Theater was above the store. It seemed that air was cooled as it passed through the ice house, then blew into the theater,

creating the "first cooling system in Newmarket."

Highland House and the Griffiths Brothers were the first buildings to have electric lights in Durham. Newmarket Electric Light Heat and Power Company built an electric power station at Wiswall Dam in 1899, so, by 1900, Durham homes and businesses began to have electricity. When people got electricity and bought electric refrigerators, ice houses became "a thing of the past."

Shelby C.



Bradley W.

INA THOMPSON — Durham

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Part 2: Other Memories of the River

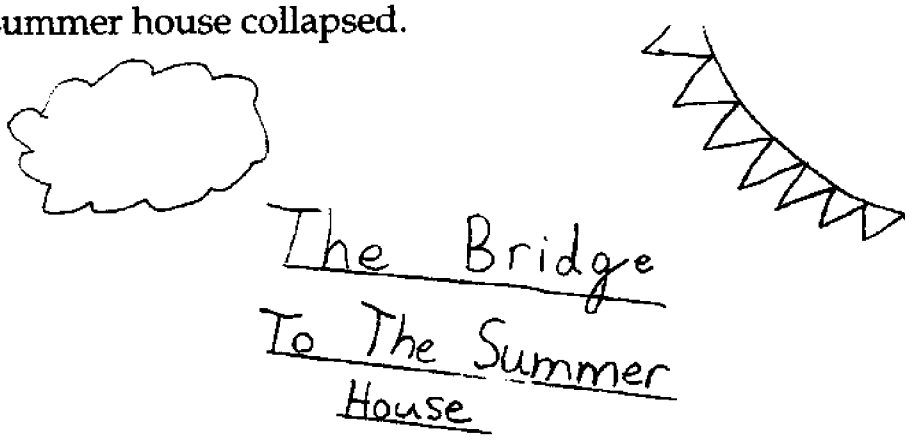
"In the 58 years I have lived here, skating was not safe until December.....When snow came, skating ended, but ice fishing took its place." When spring cam, the ice went out. "Bets were made (on the exact date when ice-out" would happen). Huge ice cakes coming from upstream would zigzag their way through the **rapids**, end over end and finally stop up against the river ice." Once the river ice was freed from the banks, it broke up and flowed to the sea. "Usually it went out in the night, and the next morning the river was once more blue and sparkling."

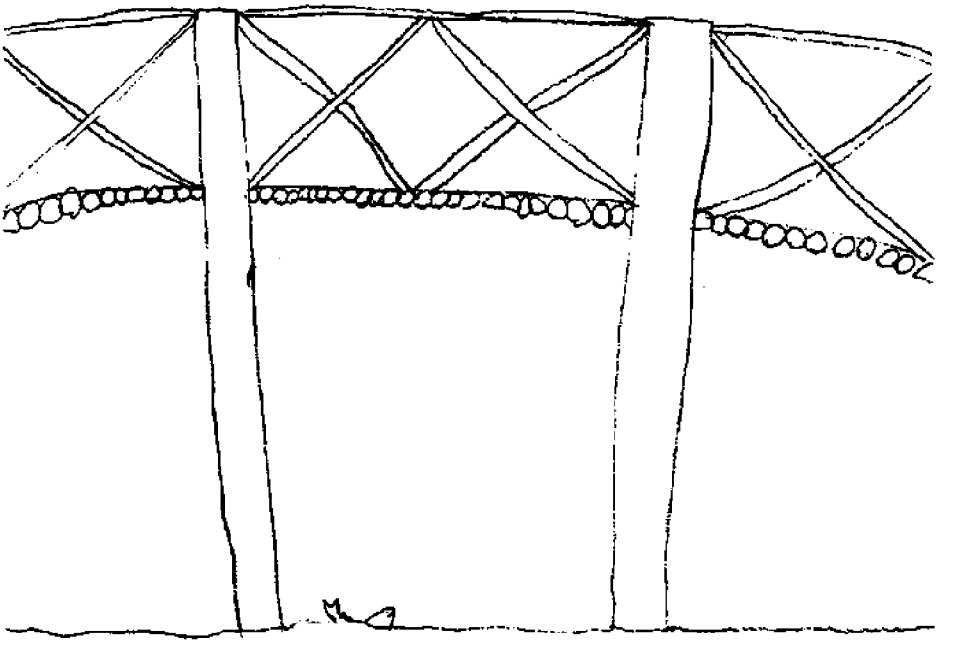
With the ice out, boats were painted and taken to the **landing**. Highland House had two white and blue row boats which often made the two mile trip to Newmarket. After tying the boat at the bridge in town, you could visit Al Place's Drug Store, Griffin's Hardware Store, Priest's men's clothing store, Mrs. Garneau's ladies shop, the La France or La Branch meat shops, a barber shop, a bank, or the post office.

"Many guests from all over the world stayed at Highland House and enjoyed the Lamprey. The children loved to fish. One day one of the young boys came home with a gunny sack filled with eels. He went to bed that night and shut the bag of eels in his closet. The next morning the eels were all over his room....The Highland House,

years ago, set out eel pots and came up with a good catch. They were considered a delicacy."

In 1932 Elizabeth Thompson, with the aid of the Dow Nurseries of Epping, built a summer house on the rock island in front of the hotel with an arched bridge connecting the shore to the island. It was a thing of beauty. People came from New York to sketch it. A sandy beach on one side was for swimming. A 1000 watt light was installed for night swimming. In 1938 a spring with heavy rain raised the river and the summer house collapsed.





Shelby C.

THOMAS H. WISWALL — Durham

Thomas H. Wiswall was the son of Thomas and Sarah Wiswall of Exeter. He was born in 1817 and went to school in Exeter. When Thomas was only 16 years old, he began working in his father's paper mills. His goal was to learn everything there was to know about the manufacturing of paper. In 1846, he took charge of a paper mill in Dover. After 3 years in Dover, he worked for another paper mill in Exeter.

In 1853 Thomas and Isaac Flagg leased a dam, mill building, and **water rights** on the Lamprey River from Moses Wiggin. The rent was $350 a year. In the lease Moses Wiggin agreed to dig a canal and build a two- story mill building equipped with two water wheels. In 1854, Wiggin dug the canal and moved a machine shop from Newmarket to the third falls on the river which are now called Wiswall Falls. Wiswall and Flagg converted the machine shop into a paper mill with modern machinery that produced wallpaper. The canal increased the water power capabilities of the site. Water wheels were built that turned the gears to operate the machinery.

The Flaggs sold their share in the business to Howard Moses. When Howard died, his father, C.C.P. Moses, took over his son's share in the partnership. At this time the company's name became T.H. Wiswall and Company.

When Moses Wiggin died, Thomas Wiswall and Joshua Parker bought all the mills at the site for $4,900. Wiswall got the paper mill and Parker got the grist and flour mill and the sawmill. Parker's mills had four water wheels. All of these buildings were two stories high.

In 1858 Thomas Wiswall bought Parker's share of the property and water privileges for $3,300. Thomas also bought out C.C.P. Moses share of the business for $1,650. Since it was nearly impossible to run all the water wheels during the dry seasons, it was better for business if one person owned all the water rights.

By 1860 the sawmill was producing only half as much lumber as it had when Wiggin operated it. The grist mill had one employee who ground 2,000 bushels of cornmeal per year. That amount of cornmeal had a value of only $2,400. But, the paper mill was making money. It employed 8 people and produced 200,000 yards of paper a year. That amount of wallpaper was valued at $30,000. The wallpaper was transported by wagon to the train depot and shipped to Boston to be sold. T. H. Wiswall was the largest industry in Durham.

Eventually, the unused mills became run down and the operation of the grist and flour mill was discontinued. The paper mill, however, continued to be **very profitable**. The main building was enlarged and two buildings were added, a bleach house and a **stock** house.

In 1868, the dam was rebuilt and houses were constructed for the mill workers. A store was operated by Austin Doeg. There were four houses on the north side of Wiswall Road. Three are still standing. The sawmill was at the edge of the mill pond and the paper mill was on the island formed by the canal. An office was located near the canal. This was the busiest spot in Durham.

By 1870 the sawmill was only producing 90,000 feet of boards worth $1,620, but the paper mill had doubled its output. The 12 people working there produced 309 tons of wallpaper valued at $69,365. The mill also had a steam engine powered by burning wood or coal.

By 1880, there were 15 workers, and 309 tons of paper were still being produced, but the value had dropped to $45,000. Wages varied depending on the job, and ranged anywhere from $.90 to $1.10 for an 11-hour day.

On November 1, 1883, the paper mill and most of the other buildings at Wiswall Dam were destroyed by fire. Two women were burned in the fire. Mr. Wiswall retired from the business, so the mill

buildings were never replaced. He was unable to sell the property. He maintained the dam and ran the sawmill until 1896 when part of the dam was washed away by the spring floods.

In 1899, Mr. Wiswall sold the land and mill privileges to James Burnham, President of the Newmarket Electric Light Heat and Power Company. Burnham built a small **hydroelectric** station where the paper mill had been. On February 20, 1900, the first electrical power in Durham was supplied to Highland House and the homes of James Burnham and the Griffiths brothers.

Bradley W.

HEDDING CAMP MEETING ASSOCIATION — Epping

Religious camp meetings were held in South Newmarket from 1857 to 1862. In 1862, a committee was formed to buy land and create a permanent camp location. Reverend Calvin Holman, agent for the committee, bought land from Ezra and Daniel Barber of East Epping. The Lamprey River crosses the northern edge of this property and provides the camp with access for swimming and boating activities.

The organization was incorporated as Hedding Camp Meeting Association in honor of Bishop Hedding. The Association consisted of pastors in the New Hampshire Conference and owners of the cottages within Camp Hedding. Some of the land was cleared and the first meeting was held there in 1863.

At first the meetings were held in a grove of trees, where a large circle of seats was constructed. Families came to relax, listen to the sometimes fiery preachers, and enjoy camping in tents. Because many people attended these meetings, the Concord & Portsmouth Railroad constructed a track from the East Epping station right into the campgrounds. In 1887 **Chautauqua** Hall was built where meetings, summer school, and lectures were held. Eventually, many cabins were built on the grounds, along with a library, bakery, recreation hall, and community hall. In 1891 a fire destroyed 10 cabins, so a water system was installed in 1892.

The name of the East Epping post office and railroad station was changed to Hedding in 1896. In 1902, electricity was supplied to the buildings within the camp grounds. The following year the camp sold spring water. In 1916 Camp Hedding for Boys was established, followed by Camp Hedding for Girls in 1918. During the Great Hurricane of 1938, 1000 of the largest pine trees on the grounds were blown down.

Hundreds of people still spend their summers at Hedding and religious meetings continue to be held on the grounds.

Dr. Isaiah D. Edgerly — Lee

Dr. Isaiah D. Edgerly (1800-1870) came to Lee from Strafford, New Hampshire. He moved here after the Civil War. He bought a large farm, general store, and mill at Wadleigh Falls on the Lamprey River in South Lee.

He converted part of the mill into a medicine mill. People from the neighborhood, including children who attended the school at Wadleigh Falls, collected herbs, roots, and bark for his mill. The children particularly liked to gather slippery elm bark because they chewed it like gum. The ingredients for the medicines were ground and mixed by eight water- powered **mortar and pestles.** The medicines were bottled at the mill. The brand name for the medicine was "Dr. I. D. Edgerly & Son." One of the bottles is in the Lee Historical Society's collection. Around 1875 the family's large two-story mill burned, but they rebuilt the medicine and **grist mill,** also adding a cider mill.

Dr. Edgerly's medicine was probably shipped by stagecoach to Newmarket, Northwood, or Durham. The stage coach stopped at Wadleigh Falls. Later, after the trains came to town in 1874, the medicine would have been hauled by wagon to the depot in South Lee, and shipped from there.

Dr. Edgerly's son, Isaiah, was married to Susan Hill. He was a Lee selectman for three years. In 1879 his daughter, Annie Josephine, who was 12 years old, went to pick pond lilies at the mill pond. The water in the pond was quite deep, held back by the big dam at Wadleigh Falls. Annie fell into the pond and drowned. Her brothers attempted to rescue her, but were too late.

Isaiah died in 1902. The mill and store are gone, but his large three story home still stands at the falls, at the intersection of Route 152 and Campground Road.

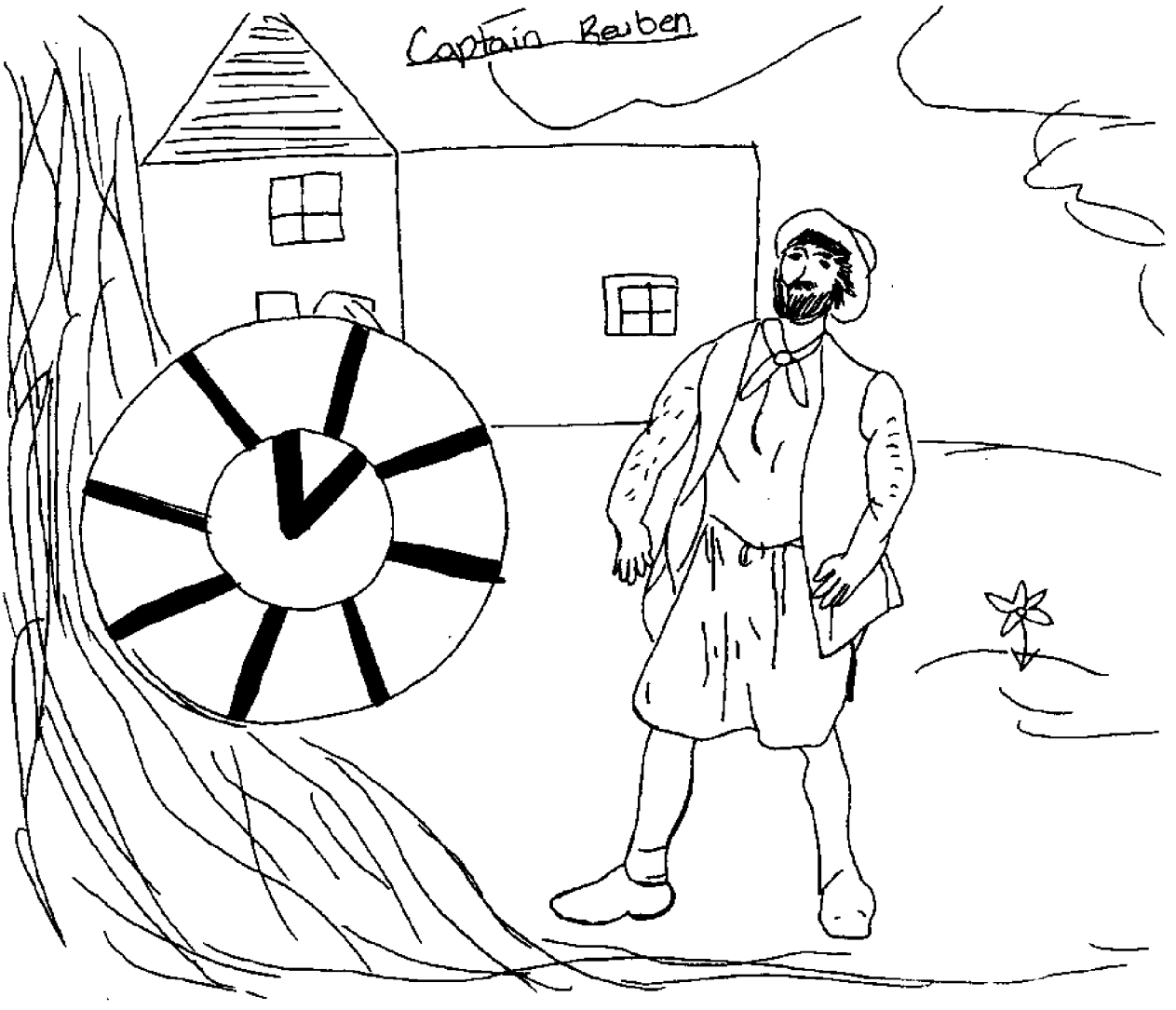
Captain Reuben Hill — Lee

Around 1750, Reuben Hill and his wife, Abigail, owned farm land and mills on the Lamprey River. His mills were above a bend in the river that we call "Lee Hook." In 1750, the town of Lee didn't exist, so Reuben's property was in the town of Durham. Reuben's mills were located near waterfalls that came to be known as Hill's Falls by the local people. His mills, a sawmill and **grist mill**, were powered by water from the Lamprey River. Do you know what a grist mill is? It's a mill that grinds grain, such as wheat, into flour.

By 1760, Reuben had built a house on a hill just south of the river. The house still stands on Lee Hook Road. His mills were on the other side of the river. Reuben also built a stone bridge across the Lamprey. There's still a bridge there on Lee Hook Road, although the stone bridge no longer exists. Do you think he built the bridge so he could get to his mills more easily? He actually charged a toll for the use of his bridge and in 1771 was paid five pounds, one shilling by the town of Lee. His bridge was known as "Hill's Bridge."

Reuben was one of 100 men who signed a letter requesting that his village be allowed to separate from the town of Durham. This letter or **petition** was written on November 18, 1765, signed, then sent to Governor Benning Wentworth and the **General Assembly** in Portsmouth. A vote was taken, the governor selected a name, and Lee became a separate town on January 16, 1766. Reuben served as a selectman for the town of Lee before he died in 1794.

Reuben also supported the fight for American Independence. First, he signed the **Association Test** promising to oppose the British armies. The Association Test was a paper that was sent to all the towns in New Hampshire by the Committee of Safety to find out how many people were **Tories**, loyal to the King of England, and how many were **Patriots**, loyal to America. Later he became a soldier and fought in the Revolutionary War.



Leah B.

ADIN AND SAMUEL JOY

Newmarket

Adin and Samuel Joy were inventors. They were the sons of Samuel and Susan Davis Joy who lived near Rockingham Junction in the southern part of Newmarket. Adin was born in 1859 and died in 1940. Samuel was born in 1861 and died in 1941. Adin lived on Ash Swamp Road and Samuel lived on the family homestead. Sam invented many gadgets. One was an oven pie lifter used to remove hot pies from the oven. This invention has a wooden handle which is attached to two metal loops. The loops are shaped like rounded triangles. You reach into the oven and attach the loops to the sides of the pie pan, then lift the hot pie out of the oven. It's amazing!

His most successful invention was the Joy Wagon Jack. It was used to hold up a wagon bed so that the wheel could be repaired. It was made of wood and metal. The part that held up the wagon looked like a set of stairs. This made it so the wagon jack could be used on different kinds of wagons, or wagons of different heights. For taller wagons, the jack was positioned under the wagon using one of the taller steps. Then, by cranking the lever, the wagon box was raised so that the wheel could be fixed.

Adin invented an adjustable wrench that could tighten or loosen wagon wheel nuts. The wrench was made of metal and had "Rockingham, N.H." cast in it. Examples of all three of these inventions can be seen at the Newmarket Historical Society.

The brothers made and sold their inventions right in Newmarket. Sam had a shop on Ash Swamp Road. His work benches were attached to a train track in the floor of the shop, so they could be moved around easily. A belt was attached to the bench's machinery, so it could be powered by **horse power, water power,** or later, electricity.

Jon B.

James Hill

Newmarket

James Hill was a landowner, lumberman, and shipbuilder. James kept a diary that tells about his life and work. He built boats for a military expedition in New York in 1755, when the English were trying to defend their colonists against attack by the French and Indians. The boats were used in battles on the Hudson River and Lake George. He also helped to build the warship Achilles in 1758 before moving with his wife, Sarah Coffin, to Newmarket in 1761. He began building ships on the river soon after he arrived. Five months later he launched a **brig** for William Whipple of Portsmouth. (A brig is a sailing ship with two masts.) James also helped to build the ship America. (See the profile on shipbuilding.)

James also served in the Revolutionary War. He was made Lieutenant Colonel of the 4th Regiment of Militia in New Hampshire. He was promoted to General of the State Militia, and was known as General Hill. He also served in the Third Provincial Congress in 1775, and was appointed to the New Hampshire General Court for several terms after that.

At first James and Sarah lived on Newmarket Neck. Sarah died in 1774, and James married Sarah Hoyt. They moved to the Moody Parsonage in Newmarket in 1784, where James lived till his death in 1811.

AMBROSE J. NICHOLS — Newmarket

Ambrose J. Nichols was one of the managers of the Newmarket Manufacturing Company. He got that job because of his hard work. Can you believe that at the age of six he was a **card tender** in a cotton mill? Just imagine working 12 hours a day for six days every week and hardly ever going to school. Ambrose only had six months of schooling in his whole life, yet he educated himself by reading books on history, mathematics, literature and more, every night. As he grew older, he was given better jobs and gradually moved to higher positions in the company. Then in 1879 he was asked to be the manager for the Newmarket Manufacturing Company. He was 45 years old.

Ambrose managed the Newmarket mills for 23 years. He built 3 new factory buildings. Ambrose also added new water wheels to provide more power to run the new engines he installed. He improved the water supply to the mill and put in better lighting systems. He also built 23 **tenement** houses. **Tenement** houses were buildings where the employees lived. Usually many families lived in the same building. Families came from many countries in Europe to work in the mills, including Ireland, Italy and France. Many came from Canada, as well.

When the cotton business was slow, he learned about the silk industry. Once he knew what his mills needed in order to produce silk cloth, he converted some of them. When he retired in 1903, the company was producing 18,000 yards of silk each week, enough to make hundreds of silk dresses and shirts for the wealthier people of the East.

He was over six feet tall and was known for his honesty, charity and friendliness.

Newmarket Manufacturing Company

In the early 1820s businessmen from Salem, Massachusetts visited Newmarket. They were looking for a location for a cotton mill. Why do you think they were interested in Newmarket? Probably the first thing that drew them to this town was the water power that could be generated by the first waterfalls on the Lamprey River. They formed the Newmarket Manufacturing Company. Agents for the company began buying up all the land that was available, especially along the river bank. In the next 80 years, they built 6 large mills in Newmarket, all of which are still standing.

In 1824 mill Number 1 was built. It was made of granite blocks and sat at the edge of the river. There were 2,523 spindles in this mill. A **spindle** is a rod that twists, holds, and winds thread. Raw cotton was spun onto the spindles by machines that ran on water power.

In 1825 mill Number 2 was built. It was also made of granite and lay at the edge of the river next to Number 1. By 1829 mill Number 3 was operating. This mill was across the river from mill Number 1 and was connected to it by a bridge. Both of these mills used water power to operate spinning machines. Just think how much thread was being produced. Mill Number 2 was destroyed by fire in 1857, but was replaced in 1858.

Then, in 1869, mill Number 4 was erected. It was a large slate building behind mill Number 2.

By this time the company had 500 people working there, threading the 39,000 spindles that provided thread for the 906 looms. A **loom** is a machine that weaves the thread into cloth. Each week, 160,000 yards of high quality cotton cloth were produced. That's about 90 miles of cloth. Some of the people who worked in the mills were young boys and girls. Imagine working 11 or 12 hours a day breathing dust and lint all day long, with only Sunday for a day off. They didn't have time to go to school to learn to read and write. Their parents were usually millworkers also.

The total payroll for a month was $11,000. That means when you

add up what each person made in a month, the total was $11,000! What's $11,000 divided by 500? It was not very much money after working for a whole month if it were now, but about 150 years ago, it was a fair amount.

Up to this point all the buildings were made of granite or slate, but mill Number 5, which was built in 1881, was made of brick. The brick probably came from the brickyards on the banks of rivers like the Lamprey. It was a large two-story building with a tower and a basement. This mill was right next to Number 4. It was filled with looms.

Now the company had 55,000 spindles and 700 employees who were producing 300,000 yards of material each week That's close to 170 miles of cloth. The monthly payroll was $17,000. What's $17,000 divided by 700? Is the pay increasing?

Mill No. 6 was built in 1892. It was connected to Number 5. Mill No. 7, constructed in 1901, was on the other side of the river, next to mill Number 3. It was also used for weaving. By 1908 the company had added 5,000 spindles for a total of 60,000. Its looms could weave 2,750,000 yards of **pongees, satins, mulls, and taffetas** in a year, which amounted to 1562 miles off cloth worth about $1,500,000. They continued to weave cottons, as well.

The story of the mills has a sad ending. The company and the town went through some very difficult times in the 1920s. The owners packed up everything and moved the business to Lowell, Massachusetts in 1929.

Why did this happen? The workers had gone on strike and wanted higher wages. The first strike was in 1921, but the company owners said they could not pay more. In fact, they asked their workers to take a cut in pay. They said there were many reasons for this. First, the silk thread being sent to the company was of very poor quality and they were having trouble selling the fabric they produced because of this. Also, people were beginning to use new fabrics, like rayon and nylon, which were made out of artificial fibers, so they weren't as interested in buying materials made of silk.

Piscataqua Packet Captains: Nathaniel Keys, Stephen Twombly, Samuel Twombly, Lemuel, William and George Drew. Gundalow Captain: Harrison G. Watson

Do you know anyone who has the same last name as one of the captains listed above? Many of these captains' descendants live here.

During the nineteenth century a **packet** service existed between Portsmouth and the Lamprey River. At first **gundalows** transported coal, cotton, and other supplies from Portsmouth to the mills in Newmarket, then carried the finished product back to Portsmouth. There the cargo was loaded onto larger sailing ships and transported to other ports.

The first gundalows were small and could carry about 10 tons They looked something like barges, sometimes with a square sail. Then larger boats were built that had more **capacity** and could carry more cargo, up to 30 or 40 tons. They were 60 to 70 feet long. These boats had a single **lateen sail, rudders, tillers,** and small cabins. The record time for a trip from the Lamprey River landing to Portsmouth was 6 hours and 15 minutes. Gundalows had to sail with the wind at their stern and with the tide pushing them along.

Harrison G. Watson (1846 -1928) from Newmarket was captain of one of these larger gundalows. His boat, the Fearless , carried brick for the new mills. The bricks probably came from the brickyards in Durham or Dover. The last gundalow to come into Newmarket was the Fanny M, captained by Edward Adams. You can see an exact replica of his boat at Sandy Point Discovery Center in the fall and in Portsmouth in the summer.

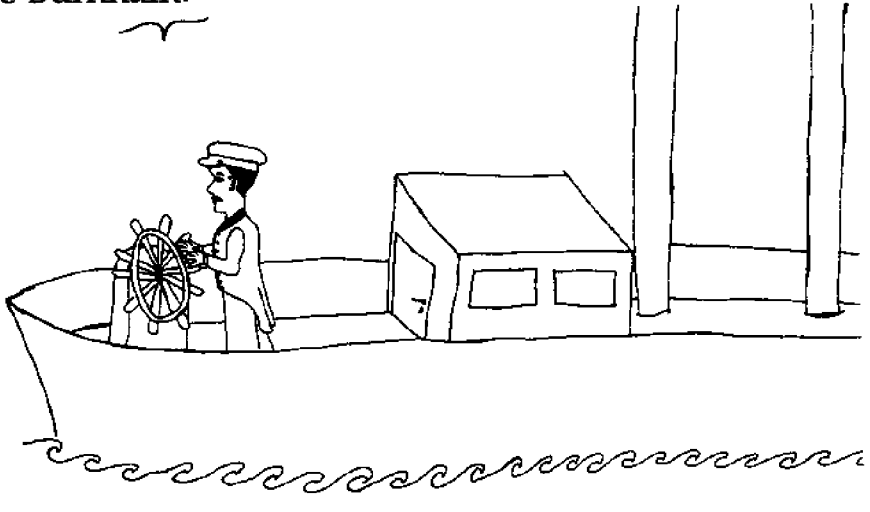
Then different boats, known as Piscataqua packets, began to sail from the towns on Great Bay to Portsmouth. They were designed to transport both passengers and cargo. The fare from Portsmouth to Newmarket was 12 1/2 cents. The service was busiest between 1820

and 1850, before trains came to the area.

The packets were 30 to 40 feet long and carried 15 tons of cargo below their deck. They had tall lateen sails and could be handled by two people. Captain Adams once saw 18 of the red and green packets off Durham Point. They sailed to Newmarket with passengers and bales of cotton and returned with passengers, the finished cloth from Newmarket Manufacturing Company, and other local products.

Nathaniel Keys was builder and captain of the Monroe , a Piscataqua packet. It was launched from Chapman's Wharf on the Lamprey in 1819. Stephen Twombly of Dover was owner and captain of the Fox, one of the first packets in the area. Later his son, Captain Samuel Twombly, navigated the Greyhound. Lemuel Drew of Newmarket owned and operated several packets, the last being the Lion. Lemuel's sons, William and George, built the Factory Girl, which sailed from Newmarket and Dover to Portsmouth.

On July 30, 1873, the Factory Girl transported 19 passengers to Adams Point for a picnic on the Bay. The people were Newmarket residents and employees of the B.F. Haley tailoring company. The picnickers returned to the boat and sailed into Little Bay. Suddenly a strong wind blew the Factory Girl up on a ledge. The packet turned over on its side, spilling the people out into the cold waters. They weren't far from shore, but many of the passengers couldn't swim. Three young girls drowned—Abbie Garland, Millie Moulton, and Jennie Burnham.



Sarah K.

In the early 1700's the towns of Dover and Exeter were growing larger. Businesses were being built. There were shipyards, sawmills, fish salting and packing companies, brickyards, **cooper** (barrel making) shops, carpenter shops, and inns. What was it that first drew European settlers the Lamprey River? Farmers came for the salt marsh hay. Fishermen came for the spring fishing. Hunters came to shoot game. Traders came to **barter** with the Native Americans who lived along the river. But finding mast trees and lumber for building ships, as well as for building houses and making other wood products, was the biggest reason. England, Virginia, the West Indies, the towns in New Hampshire, and other places in New England needed the timber and wood products.

People made their way into the forests of Newmarket, Newfields, Nottingham and Lee, where they began cutting down trees. Lumber and logs were hauled by oxen from the woods to the landing near the mouth of the Lamprey. The tallest, straightest white pine trees were reserved for the King of England's ships until after the Revolutionary War. Most of the timber was shipped to Portsmouth, Dover, or Exeter on gundalows, but some of it stayed in Newmarket.

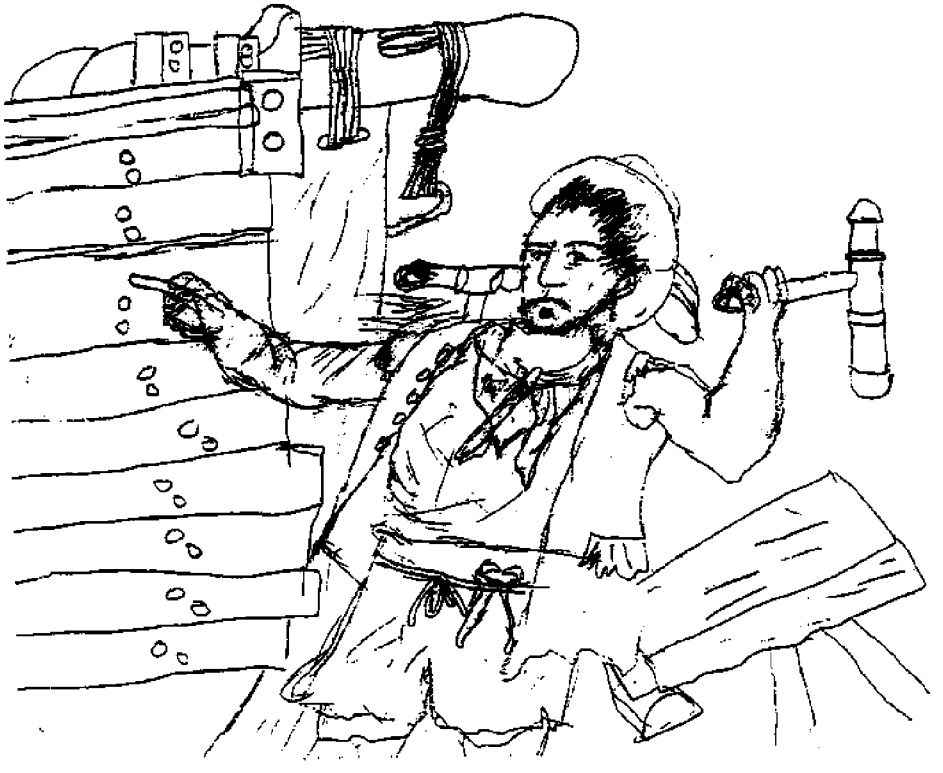
Shipbuilders and their crews began to build ships right on the banks of the Lamprey. One year, 21 ships were built at the landing in Newmarket. Seven ships could lie in the shipyard at one time. The work was so important **shipwrights** didn't have to participate in militia training. How exciting it must have been when a crew finished their work and was ready to send a new ship down the river, and out into Great Bay. The day a ship was launched was a time of celebration for the whole town.

According to Nellie George in Old Newmarket, one of the ships built at Newmarket was the brig Rokeby. It was launched and taken down through the bays and Piscataqua River to Portsmouth where it

was outfitted and placed under the command of Captain John Parrot.

General James Hill, a **shipwright** from Newmarket, got the timber for the war ship America at the landing. The America was one of the largest ships built on the east coast at that time. When she was completed she had 74 guns or cannons. The Continental Congress ordered that she be built in 1776. She was designed by William Hackett of Exeter. Congress sent John Paul Jones to Portsmouth to oversee the construction of the ship. Captain Jones was a famous sea captain who commanded war ships for America during the Revolutionary War. You can see his house in Portsmouth. It is open to the public in the summer.

The America was launched in 1782 and given to France. This was disappointing to Captain Jones, but Congress didn't have the money to outfit her. Also, the French ship Magnifique had sunk in Boston Harbor trying to help our country during the war, so the America was a gift from our country to a friend and **ally**. It replaced the Magnifique and became part of the French Navy.



Sam E.

Jonathan and Susannah Clark — Northwood

Northwood Ridge is the source of the Isinglass, Lamprey and Suncook rivers. Water flowing down the eastern side of the **Ridge** forms the Lamprey River that reaches the Great Bay in Newmarket and eventually, the Atlantic Ocean. Water flowing down the other side forms the Isinglass and Suncook rivers. Both of these rivers pour into the Merrimack, which empties into the Atlantic Ocean in Massachusetts.

Jonathan and Susannah built their home on Northwood Ridge around 1780. They planted an elm tree in their yard soon after the house was finished. Because the Ridge has a clear view of the Atlantic Ocean, ships sailing into Portsmouth Harbor used the Clark's elm tree as a landmark. In the 1920s the huge Clark elm was damaged by fire and had to be cut down, after living almost 150 years. If the tree could speak, think of all the events and people it could have told about.

Philip and Jonathan Hoitt — Northwood

Philip Hoitt was born in Northwood in 1771. He married Dorothy Godfrey in 1790. By 1794 he and Dorothy were living on the eastern side of Saddleback Mountain which is near the southern border of Northwood. Philip and his son, Jonathan, gradually added land and buildings to their farm.

Like many farmers of the time, the Hoitts raised sheep, then spun and wove the sheep's wool to make their own clothing. They also raised flax, which was woven into linen or **linsey-woolsey**, a cloth made from flax and wool. Other items produced on their farm were soap, candles, quilts, rugs and shoes.

The Hoitts carried on two other activities at their farm that were not as common to most farms in the area. They made their own pottery and wooden ware. The Hoitts' pottery was called **redware** because it was made of brick clay. This type of clay is red because it contains iron oxide. Today, no one knows where the Hoitts' clay came from. Were there deposits of clay along the streams that flowed near their home and eventually poured into the Lamprey River? Perhaps the clay came from Epping, where there were many clay deposits. Their pottery was made behind their home, in a small building that had a foot-powered potter's wheel and shelves where the pottery dried. Outside the shop was a **cylindrical** brick kiln with a **domed** top where the pottery was fired for 25 hours. Then the redware was glazed and fired again. The Hoitts made plates, cups, pots, and pans in their shop.

On a stream below their home the Hoitts also had a woodworking mill. Water power operated a **lathe** where plates, spoons, and other items made of wood were created. When a shovel or rake handle broke, Jonathan probably ran down to the mill to make a new one.

The Dudley Family

Raymond

The first Dudleys to come here were active in politics and church affairs. Thomas Dudley was the first member of the family to come to America. He arrived in 1630 and was governor of the **Province** of Massachusetts. One of his sons, Joseph, was also a provincial governor. Another son, Samuel, became the pastor of the Congregational Church in Exeter in 1650.

Colonel Stephen Dudley, grandson of Reverend Samuel Dudley, was born about 1688 in Exeter. He was a shoemaker who wore a red coat, ruffled shirt, and powdered wig. He married Sarah Davidson of Newbury, Massachusetts. Stephen purchased land, now Raymond, from an Indian **sagamore** or chief, and probably built the first sawmill in that town around 1725.

The area where Stephen Dudley built his mills was called Freetown and his mills were known as the Freetown Mills. They were located on the banks of the Lamprey River. On the west side of the river the Dudleys had a grist mill for grinding corn and wheat. Its wheel was ten feet in **diameter** and stood upright. The sawmill was on the east side of the River and had a straight saw blade that moved up and down as a log was pushed, end first, against it. The log would be run through the saw several times to make flat boards.

There is an old picture of Mr. Dudley's Freetown Mills that shows a bridge crossing the river beside the mills. In the picture, two men are washing their sheep in the river while another rides over the bridge on horseback.

As settlers moved west, Native Americans resisted their advance. John Dudley, Stephen's brother was killed in the nearby town of Fremont in 1710. He was just 18 years old. Another brother, James, was born in 1690. He was a **cooper** (barrel builder) and a lieutenant in the militia. He was the father of Judge John Dudley of Raymond.

Lesson 6

A Message to the Lamprey River

Overview:
This lesson gives students the opportunity to express their ideas and newly gained knowledge about the Lamprey in a self-selected style. Students will have spent time during previous lessons learning about the many fascinating aspects of the River. They will now have the opportunity to write a letter, sketch or paint a picture, or design a self-expressive project honoring the Lamprey River.

Focus:
How will each student express ideas and newly gained knowledge about the River?

Duration:
varies with the individual project

Learning Objectives:
Students will be able to:
- express their knowledge about the Lamprey River
- design a project which shows an appreciation of importance of the Lamprey

Materials:
To be determined individually by students, depending upon their project

Procedure:
1. Have students gather their science/personal journals, maps and any other materials they have collected pertaining to the Lamprey River.

2. As a group, discuss what students now know about rivers and in particular what they now know about the Lamprey River. Allow students to refer to their journals and notes during the discussion.

3. Explain to students that they will be designing a project in which they in some way express the importance of the Lamprey River to their school and local community. Allow students time to discuss ideas they might have as to how they could do this. Some suggested projects might be a letter written to the River, a sketch or watercolor painting of a favorite spot along the River, a brochure outlining some important features of the River, a timeline showing the historical development of the River, a products map showing the variety of items which were produced or transported on the Lamprey River, a research paper on one of the many individuals who lived on or made their living from the Lamprey River or a play written about the River.

5. You may want to end your Unit study about the Lamprey by inviting parents, school community members, and community members with an interest in the Lamprey River to a "River Festival" at which your students share their projects.

Dear Lamprey River,

I have learned a lot about you. I know all the towns that you travel through. I learned that you have been here for a long time and that you helped lots of different people.

I liked learning about the Native Americans best. They used you to get from one place to another in their canoes. They made their canoes out of trees that lived close to you. They also got food from you. Did you like having them use you to survive?

When I saw you at Betty's Meadow you were very small. In Newmarket you were big. I liked watching the birds and animals.

In the summer I swim in you and in the winter I like to ice skate on you.

Thank you for being so kind.

Your friend,
Cynthia

Dear friend,
I wrote this poem about you:

Swiftly flowing, quietly going
Water deep and cold.
Gently singing
Loudly ringing
Running big and bold.

I had fun learning about you. I hope I can visit you again.
Sincerely, Nora

RESOURCES

Note: The following resource list is divided into four sections: (1) General Resources includes books, videos, articles, pamphlets, natural history guides and historical society files; (2) Children's Fiction; and (3) Activity-based Presentations; and (4) Resource People and Historical Societies; and (5) addresses of Science Supply companies. Those programs that are starred (*) are available through Sea Grant Extension's Marine Education Resource Center, Kingman Farm, University of New Hampshire, Durham, N.H., 03824. (603) 749-1565.

General Resources:

An Unchartered Town: Newmarket on the Lamprey - Historical Notes and Personal Sketches," by Joseph Harvey, **The Granite Monthly: A New Hampshire Magazine**, Volume 40, pp. 33-76, 1908.

A Bicentennial History of Epping, New Hampshire, by Richard B. Sanborn, 1994.

A Brief History of Highland House, by Richard Lord.

***Drowned Valley: The Piscataqua River Basin**, by John P. Adams, University Press of New England, 1976.

"Cultural Resource Assessment, Phase 1," **Wiswall Falls Hydro-Electric Project**, 1985. by Charles E. Bolian and Jeffrey P. Maymon.

Earth Science Library: Rivers and Lakes, by Martyn Bramwell, Franklin Watts, 1986 .

Eyewitness Books: Pond and River, Dorling and Kindersley

Eyewitness: Pond and River, narrated by Martin Sheen, BBC World wide Americas and D.K. Vision, 1996 (video, 35 minutes).

"Items Sought Which Tell Lee's Past," by Renata Dodge, **Transcript**, Volume 5, No. 34, July 8, 1980. Ms. Dodge collected information on the Lee area for many years. These documents can be seen by appointment at the Lee Historical Society.

History of Epping, New Hampshire by John J. Tilton, 1941.

Lamprey River Resource Assessment, by Margaret Watkins, 1994.

Lamprey River Village, the Early Years, by Sylvia Fitts Getchell, Newmarket Press, 1976.

The Lamprey River Watershed Guide, edited and designed by Cynthia Lay and Barry Kane, Foster's Daily Democrat.

Landmarks in Ancient Dover, New Hampshire, by Mary P. Thompson, Durham Historical Association, 1965.

Lee Historical Society Folders about Dr. Isaiah Edgerly, Reuben Hill, Robert Parker and Wadleigh Falls.

Lee in Four Centuries by Ursula Baier, Editor, 1966.

Lee, New Hampshire by John Scales, 1916.

National Audubon Society Pocket Guides, Alfred A. Knopf, Inc.
Birds, Lakes and Rivers, Butterflies, Flowers, Insects and Spiders, Mammals, Mushrooms, Reptiles and Amphibians, Rocks and Minerals, Trees, and Waterfowl.

National Audubon Society Nature Guides: Wetlands, by William A. Niering, Alfred A. Knopf, Inc., New York, 1998.

Nature Crafts for Kids, by Gwen Diehn & Terry Krautwurst, Sterling Publishing Co., Inc., 1992.

The New Hampshire Atlas and Gazetteer, DeLorme Mapping Company (Use newest edition available).

Old Newmarket, New Hampshire: Historical Sketches. The Newsletter Press, 1932.

Peterson First Guides: Trees, by George A. Petrides, Houghton Mifflin Company, 1993. Also, Birds, Butterflies and Moths, Caterpillars, Fishes, Insects, Mammals, Reptiles and Amphibians, Rocks and Minerals, and Wildflowers.

A Pictorial History of Raymond, New Hampshire, 1764 to 1976, Raymond Historical Society.

***Ports of the Piscataqua**, by William G. Saltonstall, Harvard University Press, 1941.

A Preliminary Cultural Resource Survey of the Lamprey River Drainage, by Jeffrey H. Maymon, 1983.

Registration and Description of the Wiswall Falls Mill Site, by Peter H. Scott of P.H. Scott Consulting Services for the National Park Service, 1987.

A River Ran Wild, by Lynne Cherry, Harcourt Brace & Company, 1992.

***River Story: The Lamprey River Through History,** Lamprey River Advisory committee and Ideaworks, 1999. (video, 20 minutes).

Some Data on the Lamprey River by Donald Sanborn, 1994.

The Tide Turns on the Lamprey: Vignettes in the Life of a River—A, History of Newmarket, New Hampshire, by Sylvia Fitts Getchell, Capital Offset Co., Inc., 1989.

The Wadleigh Falls Site: An Early and Middle Archaic Period Site in Southeastern New Hampshire, by Jeffrey H. Maymon and Charles E. Bolian, 1992.

Wadley's Falls. by Frank A. Davis, M.D., 1965.

Children's Fiction:

Letting Swift River Go. by Barbara Cooney, Little, Brown & Co., 1991. (This is about the building of the Quabbin Reservoir in Massachusetts and describes life on one of the rivers that was flooded by the waters held in the Reservoir.)

Down the Mast Road by John M. Duncan. McGraw-Hill, 1956. (Imagine yourself a young person going with the men and more than 20 teams of oxen into the woods to fell the huge white pine trees that were used as masts for the sailing ships.)

Lyddie, by Katherine Paterson. Lodestar Books, Dutton, 1991. (A young girl begins to work in the cotton mills in Lowell, MA. Long hours, small pay, but a chance to learn many things.)

Hannah's Fancy Notions by Ross. Once Upon America series. Puffin Books, 1992. (Hannah works in a factory that produces laces, buttons, ribbons and other "fancy things." It helps the reader learn what mill workers' lives were like.)

Activity-based Presentations:

***Watersheds**. Presented by the UNH Marine Docents through their SEATREK program, it focuses on importance of protecting watersheds and includes model building, explorations with the Enviroscape, and a non-point pollution component. (1 hour, cost: $40)

***What's so Great About Great Bay?** A slide program which presents the Great Bay Estuarine System. A short description of the Lamprey River is a part of the program. SEATREK program, (1 hour, cost: $40)

Resource Organizations and People:

Historical Societies: Historical society museums have many artifacts that help us learn things about our ancestors. The people connected with the societies have lots of information to share or know a source that will help you learn more about your subject. Since chairmanship of the societies changes rather often, we are providing a list of people who are connected to the historical society in their town. You may want to contact them for more information.

Candia:	Mable Brock 483-2308
Deerfield:	Roger Hartgen 463-7114
Durham:	Museum number ..... 868-5436 Richard Dewings..... 868-7523
Epping:	Museum number ..... 679-2944 PO Box 346, Epping, N.H. 03042
Lee:	Marge Keeler 659-5925
Newmarket:	Museum number ..... 659-7420 Open Thursdays 2:00-4:00 Memorial Day to Labor Day
Northwood:	Janet Clark 942-8506
Nottingham:	Duke Delp ..... 679-5739 Joy Gannett 679-1937
Raymond:	Ramona Stevens 895-2927

Lamprey River Advisory Committee

Judith Spang, Chair 659-5936
Sharon Meeker, Outreach Chair 659-5441

Science Supply Companies

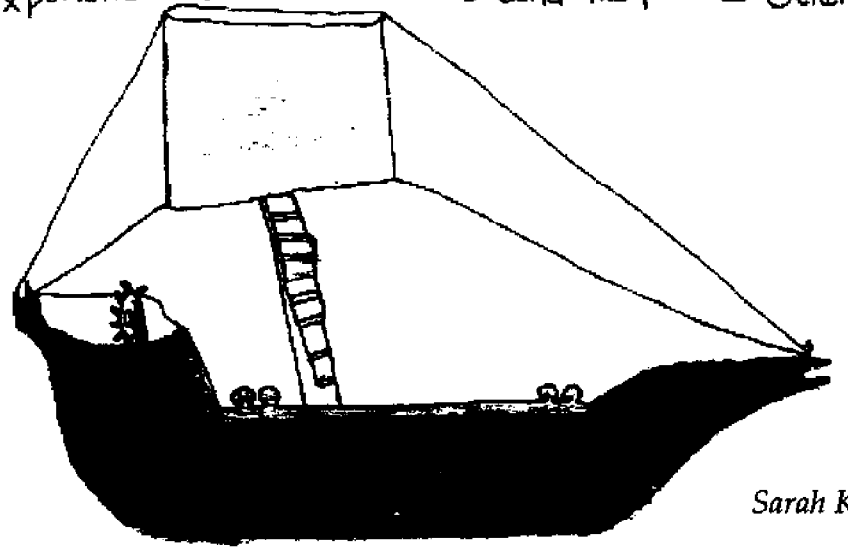
LaMotte Company, P. O. Box 329, Chestertown, Maryland, 21620
(410) 778-3100.

CHEMetrics, Inc., Route 28, Calverton, Virginia, 20138
(800) 356-3072 (540) 788-9026

HELP WANTED!

Crew wanted for shipbuilding for Captain Robert Parker.

Experienced workers wanted to build the privateer General Sullivan.



Sarah K.

Mr. Hoitt making "red ware" pottery

Brooke P.