An Educator's Guide to the

Wetland Activities for the Delaware Estuary

Discovery Kit

written by Gary Kreamer, Coordinator
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WELCOME TO WADE!

A marsh hawk glides serenely through the summer sky on its morning hunt over a sea of salt marsh grass greenery. Fiddler crabs scurry by the thousands across sun-baked muddy, low-tide-exposed stream banks. A mother merganser and five ducklings wind their way effortlessly in early evening exploration of the edges of a shallow coastal pond. A large green-eyed dragonfly hovers helicopter-like over a cattail stalk and suddenly zooms off in a blur across the open water of a freshwater marsh. A chorus of tree frogs fills the spring swampside night with a persistent high-pitched peeping.

These and many other natural wonders await those of us who take the time to pause in our busy lives and enjoy the richness of the wetlands around us. This project is all about opening the door that leads to awareness and appreciation of these treasures. Don't be mislead! The activities contained herein cannot transport you to that deep and dismal swamp where the peepers peep and the barred owl hoots, or let you drink in the rich smell of the spring air by the marsh banks where the fiddlers scurry and the harrier hunts, but what they can do, is offer you and your students an opportunity to get started down the path of wetlands learning, and acquire knowledge that will enhance and engender many future up-close experiences like those above.

Perhaps, more importantly, we hope that through these and other activities, your students will be inspired to become future friends and stewards of our wetland resources. The history of our human relationship with wetlands thus far has been largely exploitative and destructive, and although we've come a long, way today in our awareness of how unique and valuable these resources are, the tendencies for abuse and misuse continue. Education can and will help make a difference. So, the fact that you're here and reading this sure is encouraging! We invite you to come on down, roll up your pant legs, and sink your toes in the soggy ground. We hope you find the *WADE*-ing worthwhile!

TABLE OF CONTENTS

Introduction to the Wetland Kit 1

Welcome to WADE 1
Acknowledgements/Credits 3
Background on the Project 7
Borrowing/Using the Kit in the Classroom 9

Wetland Kit Activity Lesson Plans & Teaching Tips 11

Fabulous Wetlands 11
Other Activities for Introducing Wetlands 13
Marsh Metaphors 15
Marsh Model 19
Name That Wetland! 23
Wetland IQ 27
WetQuest 31
Wetland Cafeteria 35
Build-a-Bird 39
Quack, Quack, Human Impact 43

Appendices 47

Assessment Answer Keys (worksheets for each activity) 47
Supplementary Resources for Extending the Kit Lessons 55
Wetland Field Trips and Programs of Local Interest 57
Assessment Masters and other handouts ..... in front/rear pockets

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Project Steering Committee: Work on the critical start-up stages of this project, including establishment of educational goals, and identification of areas for activity development, was achieved through convening a "Wetland Kit Think Tank". Gratitude is expressed to the following educators and scientists from Delaware's Department of Natural Resources and Environmental Control (DNREC) and the U.S. Fish and Wildlife Service (USF&W) who took part in that committee, and made many thoughtful, on-target contributions to, this process..

Mark Biddle, Wetland Scientist, DNREC, Division of Water Resources, Wetlands Section
Pearl Burbage, Water Quality Educator, DNREC, Division of Water Resources
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Karen Day, Educational Specialist, U.S. Fish and Wildlife Service, Delaware Estuary Project
Anne Fitzgerald, Adopt-a-Wetland Coordinator, DNREC, Office of Information & Education
Ray Hunt, Aquatic Resources Education Assistant, DNREC, Division of Fish and Wildlife
Marion Johnson-Pohlman, Outdoor Recreation Planner, Bombay Hook National Wildlife Refuge
Gary Kreamer, Aquatic Resources Education Coordinator, DNREC, Division of Fish and Wildlife
Tom Moran, Wetland Scientist, DNREC, Division of Fish and Wildlife, Mosquito Control Section
Nancy Rolli, Environmental Educator, DNREC, Office of Information and Education
David Small, Chief, DNREC, Office of Information and Education

Student Design Teams: One of the unique features of this project is that the original activity station design plans were developed by teams of high school students, working with "mentors" from DNREC and USF&W. In other words, the concept for each activity station was designed by students (at the high school level) for students (at the junior high and upper elementary level). The outstanding creative contributions of these students are at the heart of the wetland kit project, and we are proud to recognize their efforts accordingly.

Wes Allen, class of '97, Milford H.S.
Jalee Brown, class of '97, Milford H.S.
Eric Dennis, class of '97, Milford H.S.
Cara Fisher, class of '97, Milford H.S.
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Sara Russell, class of '97, Milford H.S.
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Mary Doran, class of '96, Milford H.S.
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Abbie Marvel, class of '97, Milford H.S.
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Brie Willis, class of '97, Milford H.S.
Arian Gimbutas, class of '95, Phoenix School
Megan McCartney, class of '95, Phoenix School
John Radcliff, class of '95, Phoenix School
Justine Spence, class of '95, Phoenix School
Joel Waters, class of '95, Phoenix School
Greg Woodward, class of '95, Phoenix School
John Armstrong, class of '96, Smyrna H.S.
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Erin Salvatore, class of '96, Tatnall School
Jeff Scofield, class of '96, Tatnall School
Will Swanson, class of '94, Tatnall School
Shauna Stepnowski, class of '95, Smyrna H.S.
Jamie Vassallo, class of '95, Smyrna H.S.

Design Team Teachers: Behind the groups of students from the four Delaware High Schools who served as "design teams" for this project, were dedicated teachers, who gave a great deal of time, both in class and out to this project. From supplementing educational information and overseeing progress, to providing tools, materials and the right touch of motivational support, these teachers helped keep things on track in the classroom. We are grateful that they were there to do what they did to make this collaboration possible.

Karen Barker, Life Sciences Teacher, The Tatnall School
Jamie Birdsong, Volunteer Intern, The Phoenix School
David Grobinski, Biology Teacher, Milford Senior High School
Amy Quillen, Biology Teacher, Smyrna High School

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Mark Biddle, Wetland Scientist, DNREC, Division of Water Resources, Wetlands Section
Pearl Burbage, Water Quality Educator, DNREC, Division of Water Resources
Karen Day, Educational Specialist, U.S. Fish and Wildlife Service, Delaware Estuary Project

Anne Fitzgerald, Adopt-a-Wetland Coordinator, DNREC, Office of Information & Education
David Hannah, Ecologist, U.S. Fish and Wildlife Service, Delaware Estuary Project
Ray Hunt, Aquatic Resources Education Assistant, DNREC, Division of Fish and Wildlife
Marion Johnson-Pohlman, Outdoor Recreation Planner, Bombay Hook National Wildlife Refuge
Gary Kreamer, Aquatic Resources Education Coordinator, DNREC, Division of Fish and Wildlife
Andrea Lewkowski, Adopt-a-Wetland Volunteer, DNREC, Office of Information and Education
Tom Moran, Wetland Scientist, DNREC, Division of Fish and Wildlife, Mosquito Control Section
Roger Wolfe, Wetland Scientist, DNREC, Division of Fish and Wildlife, Mosquito Control Section

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Kit Reproduction: The herculean task of reproducing all eight activity stations and assorted accompanying materials (with the aim of making the Wetland Kits available for use throughout Delaware), was given an equally mammoth boost when in the fall of 1995, representatives of Public Service Electric & Gas (PSE&G) of New Jersey agreed to assume this responsibility as part of their multi-faceted Estuary Enhancement Program. As a result of that agreement, between January and April of 1996, staff of PSE&G undertook and completed the major job of restructuring and reproducing ten copies of the kit, including five "clones" now available for use in Delaware, and five more for use in the Delaware Estuary drainage area of Southern New Jersey. To this end, special thanks are extended across the Bay to Marcie Walton and Gary Blake of PSE&G's Estuary Enhancement Program for their ongoing committment to, and efforts made in facilitation of, doing this project right, and to the following individuals in PSE&G's Display Department, who did a nothing-less-than-outstanding job in crafting a finished product we can all feel proud of.

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Background on the Wetland Kit

Background

The idea for the Wetlands Discovery Kit project had its origins in the results of a 1993 needs assessment for Aquatic Resources Education (ARE) in Delaware. In that survey, teachers at all grade levels statewide selected hands-on learning kits first from a menu of options for kinds of materials needed, and identified wetlands as a priority topic for program development. As a result, development of a Delaware-specific, wetlands learning kit became a high priority goal for Delaware's new ARE program. Based also on input from the assessment, it was decided that this "kit" should target upper elementary to middle school students. Subsequently, in late 1993, a steering committee of wetland educators and scientists from Delaware's Department of Natural Resources and Environmental Control (DNREC) and the U.S. Fish and Wildlife Service (USF&W) at Bombay Hook was convened, and began mapping out approaches.

Around this time, Delaware ARE was contacted by the State Office of Volunteerism and asked to work with a small group of students from the Phoenix School in Wilmington, in preparing them to take part in a tri-state project called *Operation Cooperation,* that would ultimately bring them to Washington DC to address legislators on wetland issues. This opportunity prompted us to try out a novel working relationship: we would work with the Phoenix students in giving them a solid background on wetlands (for their work in *Operation Cooperation*), and the Phoenix kids would in turn help us develop and pilot activities for the Wetland Trunk.

As the steering committee identified topics and objectives for inclusion in the Trunk, it became clear that there was much more to do (in activity development) than the small group of Phoenix students could handle, so we decided to bring in some other schools to work with us in the same way. These schools, which included Smyrna High School, Milford High School and The Tatnall School, were selected primarily through interest communicated by teachers who responded to the needs assessment.

To facilitate the planning process, a "mentoring" system was devised, where each of eleven topic areas (identified by the committee) for activity development were matched with an appropriate scientist/educator (from DNREC or USF&W), who was in turn linked with a small group of "design team" students from one of the four high schools. Each school was invited to the ARE Center for a full day of wetlands education activities, a project overview, and an initial design team/mentor meeting. Objectives for each activity station were established and background material was disseminated to help enrich student knowledge and interest in their respective topics. In several subsequent meetings (during the spring of 1994), mentors visited the school and worked with each design team. This commenced with a session or two of brainstorming activity ideas, followed by a session of narrowing down and deciding on one of these, and finished with construction of the rough model activity station.

These rough model stations were field tested in selected elementary/middle school classrooms (in the same districts where they were developed) during late spring and fall of 1994. Where schedules permitted, high school design team students participated in these pilotings, working with the younger students as activity facilitators. Otherwise, these pilotings were overseen by the mentors and ARE staff. The feedback and observations derived from these experiences, along with field testing of the stations by ARE staff at a series of special events and teacher workshops during the last half of 1994, proved extremely helpful in identifying areas for improvement for the next phase of the project.

Delaware ARE staff spent the first half of 1995 in intensive efforts aimed at turning the rough model activity stations into finished quality prototype form. Based on feedback from the rough model piloting, two pairs of stations were merged: elements of a watershed station were incorporated into the *Marsh Model*, and elements of the original wetland plants and endangered species stations were merged into the activity we now call *WetQuest*.

One other original station, dealing with mosquitoes and wetlands, was dropped because of inability of the design team to complete their part of the project.

For each of the eight activity stations remaining, plans were drawn up and folding wooden boxes constructed to contain the materials, instructions, clue cards, and other activity components. An artist was recruited to produce the artwork for *Wetland Cafeteria* and *WetQuest*, and a wood carver was found to tackle design of bird parts for *Build-a-Bird*. While all this was going on, ARE staff set to work (based again on pilot phase feedback) simplifying, streamlining, and otherwise improving the quality of the instructions, clues and other text pieces for each of the activity stations. All work on this phase was completed in time for unveiling the prototype at a 1995 Earth Day Event in Delaware.

In the year following the Earth Day unveiling, the focus shifted to development of a plan and process for "cloning" or reproducing each of the eight activity stations three times, so that copies of the kit would be available for teacher loan in each of the three Delaware counties. This objective was given a major boost in late 1995, when representatives of Public Service Electric & Gas (PSE&G) of New Jersey agreed to assume responsibility for this task as part of the environmental education focus of their Estuary Enhancement Program. During the winter/spring of 1996, PSE&G's Display Department, using our prototype displays as a guide, resized, restructured, and reproduced each of the activity stations ten times, making available five copies of the kit for use in Delaware and five more for New Jersey.

As part of these efforts, Delaware ARE worked with PSE&G in New Jersey-izing the three stations (*Name That Wetland!*, *Wetland IQ* and *WetQuest*) that were designed with Delaware-specific content. Additonal efforts in 1996 were put into identifying, procuring and reviewing a variety of wetlands education videos, posters, and activity books (for use in the supplementary resources component of the kit), writing the Teacher's Guide for the kit, and organizing workshops for training teachers in its use. The fruits of all these efforts were realized in May, 1996, when the finished products were made available to the first group of teachers in Delaware, and in the fall of 1996, when the New Jersey version of the kits were introduced for use in that state.

Overview and Objectives

The Wetlands Discovery Kit was developed primarily to provide teachers with a comprehensive, classroom-ready, hands-on, tool to introduce and enrich wetlands education efforts in area schools. Secondarily, the learning stations were viewed as exhibits that could be used to educate the general public about wetlands at special events, *Adopt-a-Wetland* workshops, and other such venues. Content-oriented learning objectives include:

- increasing awareness and appreciation of the many benefits of wetlands in our world
- developing knowledge of characteristics that define wetlands, both in general and by type
- introducing users to the variety of wetland types in the Delaware Estuary area, and the significance of that habitat diversity to the diversity of plant and animal life forms there
- promoting understanding of ecological concepts and processes relating to wetland environments
- educating users about human impacts on wetlands and the importance of sustaining and stewarding these valuable resources

The Wetland Kit was designed to deliver these and other "what it teaches" messages, by utilizing the following "how-it-teaches" approaches:

- making the activities amenable to a small-group, hands-on approach to learning
- using a variety of game-style formats to make the discovery process fun and engaging
- providing problem-solving challenges that inspire creative thought and investigation
- offering opportunities for cooperative learning and decision-making
- presenting "learning centers" that can be used in various ways and in a variety of situations

More specific infomation on skill and content objectives are provided under the respective introductory sections to each of the eight activities.

Borrowing & Using the Wetland Kit

Borrowing the Kit in Delaware

Before qualifying for loan privileges in Delaware, a teacher is required to attend a six-hour *WADE* (*Wetland Activities for Delaware Educators*) workshop at the ARE Center. Delaware ARE staff are also willing to come to your school and in-service a group of (six or more) teachers in use of the kit. In either case, teachers need to complete a kit loan request form (provided with this guide), indicating 1st, 2nd and 3rd choices for preferred weeks of use. Reservations will be filled on a first-come-first-serve basis (relative to receipt of requests). Kits will be loaned out for a week-and-a-half time period: to be picked up on the Thursday or Friday before the week reserved, and returned no later than the Wednesday following the reserved week.

Teachers will be responsible for making the necessary arrangements for both picking up and returning the kit. As these exhibits are fairly substantial (in space and weight), we recommend using a station wagon, van or pick-up truck (with a cap) to ensure that they will fit readily in your vehicle. A folding cart is provided for ease of transport between vehicle and classroom.

When you request to borrow the wetlands kit, you are also given the option of requesting to pick up the supplementary resources component of the kit in advance of your loan of the kit activity exhibits. This part of the kit, which is packaged in an easy-to-carry rubbermaid trunk, includes some well-worth-using videos, posters, magazines, activity books and other wetlands-ed. enrichment materials. We offer this option for teachers who may wish to plan before and/or after kit use activities that will extend and enrich the wetland learning experience. We only ask that, as with the other materials, you inventory and return all materials in good condition by the due back date, so that the next group of scheduled users have them in time for their program.

As an alternative to you bringing the kit to your classroom, Delaware ARE also offers teachers the option of bringing your class to the wetlands kit. This can be arranged in various ways, depending on your class size, grade level, timeframe and interests, by calling the ARE Center at (302) 653-2883. Opportunities are also provided for wetlands field trip experiences and overnight accomodations. There is no charge for any of this other than the cost of your transportation to and from the Center.

Teachers borrowing The Wetland Discovery Kit should receive the following materials:

- one 21" x 15" x 9" plastic tub, containing the *Marsh Model* activity station materials
- one 21" x 31" x 3" exhibit box, containing the *Marsh Metaphors* activity station
- one 21" x 31" x 3" exhibit box, containing the *Name That Wetland!* activity station
- one 21" x 31" x 3" exhibit box, containing the *Wetland IQ* activity station
- one 21" x 31" x 3" exhibit box, containing the *WetQuest* activity station
- one 21" x 31" x 3" exhibit box, containing the *Wetland Cafeteria* activity station
- one 21" x 31" x 3" exhibit box, containing the *Quack, Quack, Human Impact* station
- one 21" x 31" x 3 " exhibit box, containing the *Build-a-Bird* activity station
- one 21" x 15" x 9" plastic tub, containing body parts for the *Build-a-Bird* activity
- one 21" x 15" x 9" plastic tub, containing supplementary resources for use with the kit
- one copy of the Teachers' Guide (three-ring binder) for use with the Wetlands Kit
- one folding cart, for stacking/transporting the kit materials to and from the classroom

Using the Wetland Kit

The Wetland Kit was developed to provide grade 4-8 teachers with a ready-to-use resource for introducing wetlands into their curriculum. Each of the eight stations is a self-contained learning center, fully equipped with instructions, clue cards, data sheets and other materials needed to do the activity. The stations can be unpacked and set up for use in a matter of minutes. All that is needed is sufficient tabletop space to spread them out, and access to a water source (for the *Marsh Model* activity).

Although the activities were designed to be used in a rotation station fashion (with small groups of students rotating from station to station every twenty minutes or so), they can also be set up as individual learning centers for students to explore as the teacher sees fit throughout the school day.

In either venue, you will need to decide how much, and what kind of, introductory activities and/or pre-kit-use briefing comments would be appropriate for your group of students and teaching situation. Although the activity stations can be used without any previous wetlands instruction, we feel that opportunities for learning will be enhanced proportionately to whatever background and preliminary activities you can provide prior to student use of the kit. The next section of this Guide offers some ideas for doing this that you might find useful.

In the same vein, any activities you can provide as follow-up to the Wetland Kit activities will be similarly beneficial. Depending on which wetland concepts you wish to extend, enhance or reinforce, the supplementary resources provided with the kit will have many ideas and materials you can use. In addition to this, we strongly reccomend following up the Wetland Kit classroom activities with a field trip experience of a wetland kind. See the Appendix for a list of such opportunities available in your area.

Regardless of what activities you choose to do before and after the kit activity stations, be sure to allow ample time to provide a briefing on the latter. Even though the wetland kit activity stations were designed to be used independent of teacher facilitation, some orientation to the activities prior to "turning them loose" would be well worth the while. For younger students, you may wish to demonstrate each activity in front of the class (with tips and information relating to each, as given in the respective activity guide sections to follow).

For older, more self-reliant students, you may only need part of a class period to go over a few general guidelines prior to initiating the activity rotation. Such a briefing might include the following points:

- Let your students know that the activities they are about to do were designed by students (teams of Delaware high school students) with the idea that students like them could have fun while they learned. This should generate more interest and enthusiasm for the activities.

- Emphasize that learning is the priority, not who got to go first, scored the highest, won the game, or any other such "fun" stuff.

- Mention that many of the activities involve working together to solve some problem or discover something, and that those who are willing to work as a team will do better, learn more, and have a better time in the process.

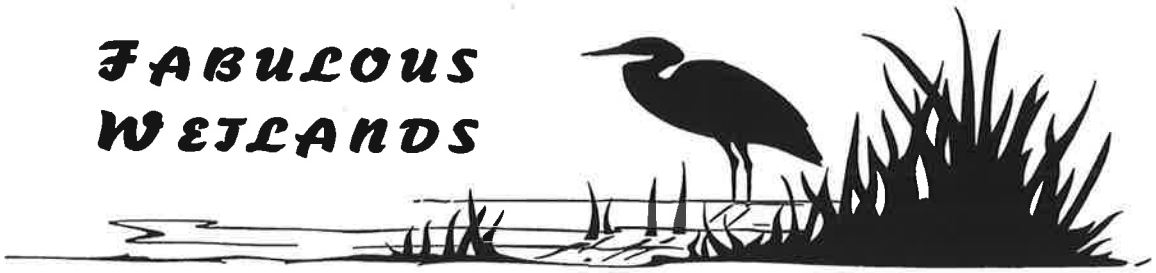
- Emphasize the importance of reading and following directions carefully before jumping into the doing/playing of any of the activities. In the long run, things will go more smoothly and successfully by doing so.

- Encourage students also to pay attention to what transpires even when it is not their turn, as what they can learn by watching what others do will help them do better when their turn comes around again.

- Tell students, that because of the rotational nature of the activities, it is vital that each group "resets" the activity for start-up by the next group before they move on to their next. One way to accomplish this is by using a bell, whistle, light switch or other device to signal clean-up time (e.g. three minutes prior to rotating), and a second signal to indicate time to move on to the next activity.

Although these activities were developed for use at the grade 4-8 level, most will work well at the high school level, and all but two *(Quack, Quack, Human Impact* and *Name That Wetland)*, have potential (with not a great deal of teacher modification) for adapting down to lower grade levels. We would be grateful to hear about any such teacher-developed adaptations or extensions applicable to use of the kit, with an eye to possible inclusion (with due credit to the developer) in future Wetland Kit trainings.

FABULOUS WETLANDS



Overview

The 9-minute video "Fabulous Wetlands"* is used to introduce students to the topic of what wetlands are and why they are important. Ideas and sources for various other introductory activities are also offered.

Objectives

After successful completion of this activity, students:

- will be able to describe the three conditions that define a wetland
- will understand that an area of land does not need to be covered with water at all times to be classified as a wetland
- will be able to offer at least three reasons why wetlands are important
- will recognize that there are several different kinds of wetlands
- will realize that humans impact wetlands in various ways

Vocabulary

hydric soils hydrophytes wetlands

Skills

listening, reading and using information, discussion

Source

*Based on the video "*Fabulous Wetlands*", 1993, Washington State Department of Ecology. This video piece can be found at the tail end of the "A World in Our Backyard" video cassette, which is included with the supplementary resources tub of the wetland kit.

Background

The word "wetland" is used to describe areas of land where the ground is saturated or covered with water for some part of the year, and plants adapted to growing in soggy soil conditions predominate. Wetlands tend to be located in low-lying areas, and often exist as transitional habitats between drier, upland areas, and those areas having deeper water. In other words, wetlands can be thought of by what they are not: as places that are neither consistently dry nor permanently submerged in deep water.

Although wetlands come in many different varieties, they all share three common characteristics:

❶ **water** present at or near the soil surface (or at least in the root zone of plants)

❷ **soils** that tend to hold water, drain slowly, and lack oxygen

❸ **plants** growing there that are adapted to living and growing in wet, poorly-drained, low-oxygen soil conditions

This unique combination of water, soils and plants also makes wetlands among our most productive, diverse, and valuable ecosystems on the planet. But this view of wetlands is, regretably, all too recent. In the past, wetlands were seen as soggy, unusable, waste places, fit only for filling in, digging out, paving over, or otherwise altering for human use. As a result, in the Mid-Atlantic area and across the United States, over half of our original wetlands have been lost. The importance of conserving what remains cannot be underestimated.

These and other messages are presented, at a level the students can enjoy and appreciate, in this video. For more information on the worth of wetlands, check out the introductory chapters of the *WOW!* book, and the *Marsh Metaphors* section of this guide.

Before Viewing the Video

Announce to students that in the week(s) ahead they are going to be studying wetlands. To do this they will be working in small groups doing fun activities designed by older students. But before we begin, it is important to understand just what a wetland is. Ask your students: *What do you think a wetland is? How would you define a wetland?*

After listing several of their ideas on the board, tell the students they will be watching a video. Instruct them to watch and listen for information that may help answer the following questions:

What makes a wetland a wetland?
Where can wetlands be found?
Why are wetlands important?
How do humans impact wetlands?

View the video together (takes about nine minutes).

After Viewing the Video

Initiate a video review/discussion with the students, using the following questions as guidelines:

- *What is a wetland? What makes a wetland a wetland? What things must be found in an area before it can be called a wetland?*

  Introduce/reinforce the three characteristics:

  ❶ **water** at or near the ground surface;

  ❷ soggy, slow-draining, low-oxygen **soils**;

  ❸ **plants**adapted to growing in such soggy, poorly drained, low-oxygen conditions

- *Where can wetlands be found? Are all wetlands the same? How do wetlands differ from one another?*

  Point out that wetlands come in many forms and can be found in every part of the state. Although many people picture wetlands as marshy-type places associated with nearby waterbodies (rivers, ponds, estuaries, etc.), make sure students also realize that our most abundant wetland type in the state consists of wet forests, further inland from rivers, bays, or ocean and that many of these and other freshwater wetlands, our fed by groundwater.

- *In the video, "The Science Guy" said wetlands can be anywhere, maybe even in your own neighborhood. What is the closest wetland the students can think of?*

  If you have a topographic or aerial map of the area around your schoolyard, use it to point out wetlands in the vicinity.

- *Do wetland areas provide any good things? What wetland values does the video show? Can anyone explain how they work?*

  Values mentioned in the video include: flood control, water cleansing, and wildlife habitat. Ask students for other ideas to add to the list. Point out that in one of the activities to come they will discover many other wetland benefits.

- *How do humans affect wetlands? Are wetlands good places for all different kinds of land use? Why or why not?*

  Someone will probably bring up the 60' deep parking lot built on the wetland in the video. Although this may seem like an extreme case, point out that in the U.S. over half of our original wetlands have been lost, mostly through human efforts to make wetlands into something they are not. In the past, many wetlands were filled, dyked or drained to be used as farmland, and more were (and still are) converted to highways, shopping malls, playgrounds, housing developments and all other varieties of uses.

- *Ask students to think about different land uses they have seen near or at the water's edge. Could any of these be destroyed wetlands?*

  Students may mention such things as: strips of shopping plazas near the beach, waterfront housing, and roads/highways along marshland.

- *Ask students to brainstorm a list of activities that could take place in a wetland without changing it drastically. Then make a second list of activities that could be harmful to a wetland.*

  This list will vary widely and may elicit some conflicting opinions amongst your students. Point out that such differences are not uncommon when dealing with humans attitudes toward wetlands.

Other Activities for Introducing Wetlands

Wading into Wetlands

Another good source for introductory wetlands-education activities is the National Wildlife Federation's "*Wading Into Wetlands*" materials, included in the supplementary resources part of your loan kit.

This includes a two-part video on wetlands (narrated by Billy B, the song and dance man) that was produced especially for NWF's 1996 Wildlife Week. The features a brief orientation segment to what wetlands are and why they're important, followed by a one-hour, live interactive show involving wetlands experts, and students acroos the U.S.A. The latter features "Wetland Safari" pieces from selected schools in different parts of the country, an interview with a Senator who heads the Congressional Committee dealing with wetland issues, a nice segment on an Eagle Scout wetland restoration project in Illinois, and lots of call-in questions from students listening in by satellite.

This video is supplemented by an activity packet, with some good classroom follow-up possibilities. For still more activities, NWF's NatureScope book of the same name (*Wading into Wetlands*) is also available. "*In the Marsh*", and "*Create a Scene*" (pp. 5-6) are among the activities offered there that we recommend for effective start-up enrichment.

Wetland Metaphors!

Another effective way of getting the class thinking about the importance of wetlands, especially after viewing *Fabulous Wetlands*, is to use the "Wetland Metaphors Mystery Bag" activity, as described on pages 85-86 of the *WOW!* book. There is no better classroom activity for introducing students to the many benefits of wetlands than this one. We offer several options for using this approach in the *Marsh Metaphors* section (page 12) of this teachers guide.

Pages 71-77 of the *WOW!* book presents a smorsgasbord of additional activity ideas for getting started with wetlands. One of these, "*Let the Cattail Out of the Bag*" (pp. 78-79) uses wetland "artifacts" to create a "touchy-feely" bag for acquainting students with the sensory wonders of wetlands.

WINGO! (Wetlands Bingo)

One approach we've used successfully as either a start-up or ice-breaker activity in wetland workshops is a game we call WINGO (for Wetlands Bingo). Each student gets a 5x5 game card grid (included as a copy master in your teacher notebook pockets) containing questions, "been-there-done-that", and other challenges relating to area wetlands.

They are then invited to circulate amongst the class to get other classmates (or teachers) to sign off (that they know, have done, or can do what the box asks) on as many boxes as they can. When any student covers five boxes in a row (vertically, horizontally or diagonally) they call out "WINGO!". Write those names on the board, to keep track of the winners. After so many minutes (or so many WINGO's), stop the game and go over the content.

This activity can be useful in several respects. Firstly, it serves as a fun way to stimulate student interest in the topic of wetlands. Secondly, it gives you a sense of who in your class knows what, who has had experiences with wetlands that might be worth sharing, and perhaps most importantly where the gaps lie in your group's knowledge of wetlands. Finally, in reviewing the game answers, it begins the process of teaching and learning about wetlands.

An answer key is provided on the next page to help guide you in processing the information presented on the *WINGO!* game card. A blank *WINGO!* master is also provided in the back notebook pocket for you to create your own customized game card.

WINGO! (Wetlands Bingo DE Answer Key)

has participated in a beach, river or wetland clean-up day in the last 3 years *Beach clean-ups take place every fall coastwide. The Christina River Clean-up is in April. For more information on either, call DNREC at 739-4506.*	can give one of three characteristics that define what a wetland is *1) water visible at or near surface for some part of the year; 2) soils that hold water, drain poorly & have little O_2; 3) plants adapted to life in such soils*	can do an identifiable impersonation of some Delaware wetlands creature *Anyone brave enough to make the effort (no matter what the critter) deserves credit here!*	can name one kind of DE-Estuary fish that does its early growing in wetlands *Over 80% of our commercially-valued fish, including: flounder, weakfish, striped bass, menhaden, perch and others use wetlands as nursery areas*	can name two kinds of turtles that can be found in Delaware wetlands *snapping turtles, bog turtles, painted turtles, box turtles, stinkpots, sliders, mud turtles & diamondback terrapins all fit the bill here*
can describe the basic difference between a swamp and a marsh *You may get all sorts of answers here, but the essential difference is that swamps have trees as the dominant form of vegetation and marshes don't.*	owns a T-shirt imprinted with some sort of wetland creature *All sorts of acceptable possibilities here: ducks, fish, crabs, insects, etc.*	can name three kinds of ducks that spend some of their time in DE wetlands *Mallard, merganser, teal, widgeon, wood duck, black duck, canvasback, gadwall, bufflehead, scaup, redhead, and many others too numerous to list.*	knows the name of the wetland (swamp) tree Trap & Trussum Ponds are noted for *Trap & Trussum are noted for their Bald Cypress swamps. The northern-most Cypress swamps in the U.S. are found here in Delaware!*	knows someone who lives within one mile of a wetland area *Answers will vary. There aren't many places in Delaware (especially below the C&D Canal) that aren't within a mile of some kind of wetland!*
can describe two ways that wetland plants can be helpful *Wetland plants clean water by trapping or processing some pollutants, reduce erosion by holding sediments, provide food for animals (and man), produce oxygen, and provide habitat.*	can name an animal that can create wetlands *An obvious choice here is the beaver, which creates wetlands through its damming activities. An astute student may also identify humans as wetland creators also (e.g. Rt. 1, DelDOT).*		can describe what *detritus* is and how it's important to wetland ecology *Detritus is dead plant/animal material. It comprises a very important part of the food chain in wetlands, especially in salt marshes.*	knows what force makes the tides ebb and flow on this planet *The gravitational pull of the moon on the Earth's oceans causes the tides. Tides are higher at full & new moons, because Earth and moon are aligned such that the pull is stronger then.*
knows the name of the DE River island famous for its large wading bird rookery *Little Pea Patch Island, just north of the C&D Canal, contains thousands of pairs of nesting herons, egrets and ibises - the largest concentration of nesting wading birds north of Florida.*	can name a critter with one big claw that makes its home in DE salt marshes *We're talking fiddler crab here, the diminutive, but ecologically-important, denizen of salt marsh and tidal stream banks throughout coastal Delaware.*	has constructed/put up a nesting box for birds, bats or other wetland creatures *Bluebird boxes are probably the most common item here; bat boxes, wood duck nesting boxes and others are all equally acceptable here.*	can give three good reasons why wetlands are worth saving *Answers to this may include: flood control, sediment or pollution filtering, wildlife habitat, nursery area for fish, resting area for waterfowl, recreational value, source of food, beauty, etc.*	knows what a *whale wallow* is and where in Delaware they can be found *A "whale wallow" is a kind of wetland (Also called a Delmarva Bay) that is very common in Delaware woodlands. Lum's Pond State Park features a Whale Wallow Nature Center.*
can name three kinds of insects that inhabit Delaware wetlands *Dragonflies, damselflies, caddisflies, stoneflies, mayflies, greenheads, gnats and mosquitoes are clearly aquatic, but butterflies, grasshoppers, beetles, and many others would also qualify.*	has watched birds at the Bombay Hook National Wildlife Refuge *People come from all over the world to observe water birds at BHNWR, so hopefully, some of your students can give it a "been there, done that".*	can name one kind of food that comes from wetlands *Cranberries, blueberries, and rice (including wild rice locally) for plants; blue crabs, crayfish, muskrat and fish provide for the carnivore's fare..*	can name one of DE's *endangered* or *threatened* species that lives in wetlands *the bald eagle, bog (not box) turtle, tiger salamander, barking treefrog, and brown pelican are all on DE's endangered & threatened list; many species of wetland plants are also*	can think of one action we can take to help care for & conserve our wetlands *Participate in a wetland clean-up; put up duck or other bird/bat boxes; join our Adopt-a-Wetland program; write to politicians in support of wetlands conservation; teach others to care!*

Circulate around your class or group in search of indivduals who can meet the specifications described in any of the boxes. When you find someone who does, have him or her sign in the appropriate box. When you get 5 boxes in a row covered (vertically, horizontally or diagonally), call out Wingo! You may use any one person's signature no more than once.

MARSH METAPHORS

Overview

Students are challenged to match clues relating wetland functions and values with metaphoric attributes of twelve objects on exhibit. Two games and clue sets are provided. The first covers basic wetland functions and values, and is played cooperatively. The second associates wetland values-related facts and impacts, and pits player against player in a card game-style format.

Objectives

After successful completion of this activity, students:

- will recognize important ecological functions of wetlands
- will understand the benefits of wetlands to humans and wildlife
- will be able to relate consequences of wetland loss to diminishment of ecological functions and wildlife/human values

Vocabulary

erosion	habitat	nutrients
estuary	metaphor	organic
groundwater	migratory	water quality

Skills

analyzing, applying, interpretting, inferring, matching, reading and using information, cooperative learning, creative thinking and problem-solving

Source

This activity was adapted from "*Wetland Metaphors*" *in* Aquatic Project WILD, Western Regional Environmental Education Council, 1992.

Background

In the past, wetlands were largely viewed as wastelands, and consequently, millions of acres across the U.S. were filled, dug, dyked, paved or otherwise altered for human use. Fortunately, these days wetlands are viewed more favorably, as areas that provide numerous ecological, economic and environmental benefits.

High on this list of wetland values is the habitat they offer living things. Many of our rare, endangered, and threatened plant and animal species make their homes in wetlands. Still others, including hundreds of water bird species, rely on wetlands as resting and "refueling" areas in their seasonal migrations. Wetland habitats also serve as spawning and/or nursery areas for the majority of our commercially and recreationally important fish and shellfish.

These fish and wildlife values in turn generate an assortment of human and economic benefits. Millions of people spend billions of dollars each year in pursuit of fishing, hunting, wildlife watching and other wetlands-related recreational activities.

The capacity of wetlands for absorbing, storing, filtering, and otherwise improving water quality likewise benefits humans in many ways. Wetlands situated along rivers, estuaries and coastal areas can significantly reduce the harmful impacts of floods and storms. In areas prone to drought, wetlands can provide a reservoir of water for human, wildlife and plant use. By trapping and holding eroding soil particles, excess nutrients, and other substances in the water, wetland plants help reduce the harmful effects of these substances on water bodies adjacent to those wetlands.

Through the *Marsh Metaphors* activity, students are introduced to these and other wetland values in a way that makes them more concrete and memorable. The chart to follow summarizes the metaphors presented. For a more detailed description of wetland functions and values, see Chapter 3 in the *Wonder of Wetlands!* book.

Before the Activity

If you feel it would help prepare your group to get more out of this activity, make some background information on the benefits of wetlands available. This could be done via: a brainstorming exercize (building a list of what the class thinks is "good" or "bad" about wetlands), video viewing (*Fabulous Wetlands* with Bill Nye) or poster/reading assignment. See the *"Introducing Wetlands"* section of this manual for more ideas on this approach.

Since these activities are based on the idea of using everyday objects as *metaphors* for wetland benefits, you may want to go over examples of what the word *"metaphors"* means. Explain that a *metaphor* uses one thing (object, place, being, idea, etc.) to represent or get across another, for example, "the Earth is a spaceship" or "the sea was a raging lion". You may wish to go over one example of how this works (such as the sponge) from the exhibit board. Instructions for playing *Marsh Metaphors* (as they appear on the exhibit) are given in the box below.

During the Activity

The clue/object matching part of Game 1 is straightforward, but students may need a little extra encouragement for the creating-your-own clues (for the two objects lacking clues) part of the challenge. Remind students to sign their names to their creative contributions (on the post-it pads), and be sure to collect all these notes for use during the wrap-up session. Also encourage the students to check and correct their matches from game 1, as this will prove helpful to them in playing Game 2.

The Game 2 clues are tougher, as they require students to apply the functions/values information presented in Game 1 to facts and consequences that tie into wetland benefits. This is also made more challenging in that one object (the sneaker) is used for two of the clues, while another (the canteen) is not used at all. Students who make use of the Game 1 information and pay attention to the incorrect guesses made during other people's turns will have a definite advantage in this game.

How to Play Marsh Metaphors

Game 1: Each object on the board symbolizes something useful wetlands do or provide. Your task is to match each object with the clue it represents.

- ☞ Take turns (alphabetical order by last name) choosing a green card from the left pocket.
- ☞ Attach this card to the velcro piece next to the object you think best fits the clue.
- ☞ Continue this way until all 10 clues are used. Notice that two of the objects are missing clues! Use the post-it pads to create your own wetland values clues for these!
- ☞ Discuss and decide as a team whether you agree with the matches on the board. If not, make any changes you agree are needed.
- ☞ Check the green answer key card from the card pocket to see how you did. Correct any misplaced matches.If time allows try game 2!

Game 2: This game plays differently, but the idea is similar - figuring out which clues (red ones this time) are matched to which objects. Here's how to play:

- ☞ The red card set contains clues that relate to matches made in game 1. Stack all the red cards, clue side up, on the table in front of you. Do not look at the pictures on the other side.
- ☞ Taking turns (reverse alphabetical order this time), read the clue on the top card out loud, and say what object you think that it matches. Look at the picture on the back of the card.
- ☞ If it matches, hold onto the card and earn the points printed on it. If you are wrong, place the card on the bottom of the desk with the clue side up.
- ☞ The player with the most points at the end of the game wins. Please return all clues to the proper pockets at the end of your game.

After the Activity

Ask students to build a list of ways wetlands are useful and important to humans and the environment (or if you started a list as a pre-activity, see what they can add to it now). If they have trouble remembering, use the objects on exhibit to prompt them. Ask them: *Do you view wetlands any differently now than before you did the activity?*

The chart below summarizes the clue matches and metaphoric relationships presented.

As you review specific objects and the wetland values associated, try to get a sense of which objects/clues were troublesome and why. Touch on additional supporting facts and information as you see fit to further emphasize the benefits of wetlands.

Retrieve the post-it pad clues created by the students for the **sneaker** and the **house**. As you go over the ideas offered, commend the students for their creative thinking. Allow opportunities to add to the list, again emphasizing that there are no right or wrong answers. The chart below presents additional ideas on benefits relating to these two objects.

Object	Function/Value (Green Clue Set)	Consequence/Fact (Red Clue Set)
sponge	Wetlands are capable of absorbing and holding large quantities of water.	Filling in or paving over of wetlands located along rivers results in increased flooding problems downstream.
canteen	Wetlands retain excess water for use by wildlife (and humans) in times of drought.	no clue for this object!
strainer	Wetlands help filter silt (soil particles) and other debris from the water.	The ability of wetland plants to trap/hold soil particles can lessen the harmful impacts of erosion on water quality.
cat litter	Wetlands trap and bind up pollutants that make their way into the water.	Experimental wetlands are being used in some places to treat sewage and other organic waste materials.
soap	Wetlands improve water quality by cleaning pollutants in the water.	Wetland plants help reduce water pollution by removing nutrients and other impurities from the water.
wire whisk	Wetlands mix up nutrients, minerals and oxygen in the water.	Twice a day in the tidal wetlands of the DE Estuary, elements of both fresh and salt water meet and mix.
baby bottle	Wetlands serve as nursery areas for fish and wildlife.	The young of over 80% of our commercially valuable fish and shellfish use wetland areas to do their growing.
house*	*provide habitat for many living things; source of timber/wood for building.*	Wetlands provide much-needed habitat for over 40 % of the endangered and threatened species in the U.S.
pillow	Wetlands serve as important resting areas for wildlife.	Over 100 species of migratory waterfowl and wading birds use Delaware Bay wet-lands to rest and refuel along their journeys.
cereal	Wetlands provide nutrient-rich food for both wildlife and people.	Cranberries, blueberries, wild rice and salt hay are examples of crop products grown in Delaware Estuary area wetlands.
sneaker*	*recreational use of wetlands; storm buffer between land and water; provide support/protection for living things;*	Coastal wetlands help reduce storm damage by providing a protective layer between water and people's homes. More than 30 million people hike, canoe and otherwise enjoy recreational values of wetlands in the U.S. each year
paint brush	Wetlands are a source of beauty and artistic inspiration.	The famous naturalist John Henry Audubon is also known for his beautiful paintings of wetland birds

* In Activity #1 (the green clue set), these two objects do not have clues. To encourage creative thinking about wetland values, students are asked to create their own clues for these objects.

Activity Adaptations

This activity is an adaptation of a classic wetlands education tool. As originally offered in *Aquatic WILD*, this involves passing out objects (like those in our exhibit) from a "Mystery Metaphors" bag and challenging groups of students to come up with wetlands associations for each object. This teacher-led approach makes an excellent introductory activity for any Wetlands unit, and to the Wetland Kit for that matter. If you do choose to go that route, the *Marsh Metaphors* exhibit will still serve as good reinforcement. See pages 85-86 of the *WOW!* book for more information on this approach.

Another effective way of doing this, particularly for smaller class sizes and younger groups of students, involves a hybrid of these two approaches:

- ☞ Assemble your own mystery metaphors bag with objects like the twelve exhibited (please don't remove the ones from the board!).
- ☞ Develop clues like those in the green set for all but two objects (e.g. sneaker and house), and attach velcro pieces to the back of each clue and object. Then attach the clues to the objects so that the matches are incorrect.
- ☞ Then explain to the group that you have this bag of items that symbolize different ways wetlands are valuable, with clues that are meant to go with each object. *But somehow the clues got all mixed up in the bag!*
- ☞ Ask your students to help sort out the mix-ups, but instruct them to do this *without talking!* Pass out one object to each student, and let them circulate and swap clues until they feel all objects/clues are correctly matched.
- ☞ Do a go-round, with each student holding up the object and reading aloud the clue that goes with it. As they do this, feel free to expand on the wetland values messages.
- ☞ After congratulating them on their efforts, make a show of reaching down into the bag, and saying something like *"Oh, no, there's a couple objects down here that seem to be without clues! Could you please help think up some wetland values clues to go with them?"*
- ☞ Write down their ideas on a post it and thank them for helping you unravel the mysteries.

Activity Extensions

Challenge students to create a bumper sticker, poster, commercial or other display promoting the values of wetlands and why we should protect them. Or assign different benefits to students for each to contribute a page towards production of a class "wetland benefits booklet". You might even target this for use in teaching younger children in your school about the importance of wetlands.

Visit a wetland to look for evidence of the benefits described in this activity. Identify those metaphors that seemed to work well for this wetland, and those that didn't. Emphasize that just because we can't see something (such as wetland plants ability to pull out and trap invisible pollutants from the water), doesn't mean it's not going on and isn't important.

Work with students in developing an opinion survey that they can use to find out how people in their community perceive wetlands. Don't forget to share the results with people who work in wetlands-education from the Fish and Wildlife or Department of Natural Resources agencies in your area.

Assessment

Have students summarize what they know about the benefits of wetlands. This could be done verbally as a group, in list form individually, or in whatever other format works well for your situation. You could also ask them to write a persuasive, editorial-style letter encouraging people to appreciate and care about our wetland resources.

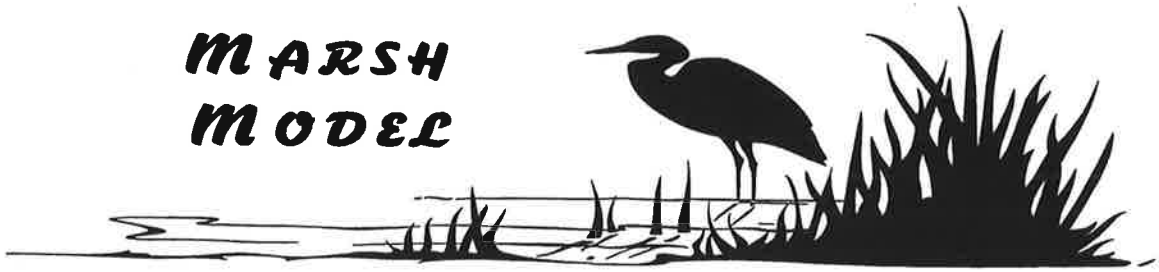
Challenge students to create wetland benefits-type clues for other everyday objects. A sample worksheet based on this approach is offered in the assessment section of this notebook.

Related Activities & Resources

"Rate a Wetland" and *"The Wetlands Gazette"* in Wetlands Conservation and Use Issue Pac, U.S. Fish and Wildlife Service. Good source of wetland values follow-up activities for the field and classroom.

"Wise Wetland Ways" in Wetlands: Water, Wildlife, Plants & People (poster), U.S. Geological Survey, Denver, CO. Students simulate the work of future archaeologists, interpreting a collection of "wetland artifacts" to tell story of how we use wetlands today.

MARSH MODEL



Overview

Students work together using a dishpan-size wetland model to perform experiments demmonstrating the water-holding function, and flood prevention value, of wetlands. This model can also be used for demonstrating sediment and pollution-trapping properties of wetlands.

Objectives

After successful completion of this activity, students:

- will be familar with a wetland's capacity for absorbing and storing large volumes of water
- will understand the importance of wetlands in reducing the impact of storms and floods
- will recognize the problem of increased runoff and downstream flooding that results from wetland loss or development

Vocabulary

absorb	erosion	filter
runoff	sediments	watershed

Skills

hypothesizing, experimenting, measuring, recording, analyzing and interpretting data, reading and using information, and cooperative learning

Source

This activity was adapted from "*Wetland in a Pan*" *in* WOW! The Wonders of Wetlands, Environmental Concern Inc., St. Michaels, MD, 1991.

Background

Among the least visible and appreciated benefits of wetlands are the preventive and ameliorative services they provide with respect to flood control, storm damage, water quality conditions and groundwater recharge. Although it's often stated that wetlands are able to reduce flood impacts by holding water that would otherwise add to flood volumes, the extent of those benefits are seldom appreciated until the wetlands are gone, and the functions once performed are no longer operative.

This was clearly evidenced in 1993 with the severe flooding in the Midwest. Huge sums of money had been spent to construct "flood control" levees along the Mississippi and its tributaries, with the intent of keeping flood waters from reaching cities and towns located along the rivers. Unfortunately, by preventing flood waters from reaching and being soaked up by the riverine wetlands, these levees forced large volumes of water downstream, to ultimately do even greater damage there. Where the levees did break, and flood waters were able to reach the wetlands, flood levels dropped several feet. Moreover, the most severe flood damages occured in those areas where past loss of upstream wetlands was greatest.*

It is estimated that the annual value of such "flood control" services (in damage repair costs) is nearly two billion dollars for the Mid-Atlantic area alone! Another 50 million dollars per year is attributed to the work wetlands do in improving the quality of water supplies in this region (through filtering and processing pollutants that pass through wetlands on their way to rivers, reservoirs and groundwater drinking water sources).* Although it's hard to place a dollar value on the role wetlands play in maintaining and recharging groundwater resources (which supply much of our drinking water in this region) this benefit also should not be undersestimated.

* from: the National Audubon Society's *Valuing Wetlands: The Cost of Destroying America's Wetlands* (copy provided in resources tub of kit).

Before the Activity

Use the sponge, canteen, and strainer metaphors to initiate a discussion of the functional values of wetlands in the areas of water quality and supply. Take a "raised hands" poll to see how many of the students believe that wetlands really do these things. Whether they do or don't, say to them: *Well, it's nice to **know** that wetlands do these things, but wouldn't it be even better if we had some way to **show** it?*

Then hold up the marsh model, and explain: *This model was designed by high school students for students like you to use in doing experiments that actually show some of these wetland functions.* Point out parts of the model and what they represent: the brown area representing the uplands, and the blue, the river, bay or other water body into which the wetlands drain. Ask the students to identify what the sponge part of the model stands for.

During the Activity

This activity lends itself well to a small group, cooperative learning approach. Indivdual students adopt the roles of "rainmaker", "wetland wringer", "runoff collector", "volume measurer" and "data recorder". These roles can be rotated in the second experiment. As you circulate, make sure that everyone is involved and realizes the importance of their contribution to the team's work.

While you are there, encourage the experimenters to be as precise as they can in following directions, measuring, recording their data, etc. Remind them to think about what the experiments show, and to be prepared to make conclusions based on their observations after the experiments are completed. Also thank them for their efforts in making sure they clean up after themselves, and return all materials to their original state for the next group to use them.

Marsh Model Instructions

In this activity, you perform experiments demonstrating wetland functions. The brown areas in the model represent uplands, the sponge a wetland, and the blue the water body (river/bay) into which the wetlands drain.

1. Using one of the graduated cylinders, measure out 500 ml of tap water. Record this amount (all measurements in metric) under the "Volume Added" section of the data sheet. Pour this volume into one of the bottles and attach the sprinkler spout securely to the bottle.
2. Make sure the stopper located at the base of the model is in place. Slowly sprinkle all the water from the bottle over the land (brown) section of the model to simulate a rain event.
3. Carefully (without dripping water if possible) transfer the sponge into the measuring cup and wring it out thoroughly.
4. Remove the sponge and carefully pour the water remaining in the measuring cup into one of the graduated cylinder provided. Record this amount in the "Volume Absorbed" data column.
5. Place the measuring cup under the drain and open the stopper to allow the water that ran off to the river/bay (blue area) to drain out. Transfer this to the other graduated cylinder and record this amount under the "Volume Runoff" data column.
6. Restopper the drain hole to prepare for the next experiment.

To show what happens when a wetland is filled in to make room for a parking lot or highway, replace the sponge with the black brick piece. Then follow all steps as above, recording all results under the Experiment #2 section of the data sheet.

Please be sure to clean up the model for use by the next group!

After the Activity

After all students have had a chance to perform the water-holding experiments, take a follow-up poll to see how many now believe that wetlands do help hold water and reduce flooding. If you notice any "converts" (from the pre-activity poll), ask them to explain why they changed their minds. If there are still cynics, ask what it would take to convince them.

This might be a good place to discuss the pros and cons of using models, and ask students for input on how they think this model makes a good representation of reality and how it doesn't. For example, in the real world, some of the water falling on the land would soak in, but in this model all the water runs off the upland areas.

Something else students may notice is that the sum of the measured volumes of water absorbed (that wrung out from the sponge) and runoff (that drained out from the river/bay), may be many ml less than what they started out with. Ask them to think about this and try to account for the "missing" water. Students will be quick to attribute this to spillage from doing the experiments, but hopefully, will also realize that a portion of the water is also held in the sponge. Point out that in the real world, wetlands will actually make more of the water seem to disappear, as some is taken up and used by plants, and still more is evaporated and lost to the air.

Ask: *When you replaced the wetland with the parking lot, what happened?* Point out that in the small wetland pan model, these amounts of water may not seem like much, but that in the real world it can mean a lot. Scientists in Massachussetts estimated that a 2700-acre wetland there supplied an aquifer with over 8 million gallons of water a day!

Ask: *How could removal or paving over of wetlands along rivers or coastal areas cause a problem for communities living downstream from where those wetlands have been removed?* This would be a good place to relate the information provided in the background section about flooding in the Midwest.

Also, although it's not as easy to show with the model, the importance of wetland water-holding capacity at the other end of the water supply regime is also worth mentioning. In times of drought (such as we experienced in this area in the fall of 1995), wetlands serve as a reservoir of groundwater for wildlife, plants and humans. When wetlands are filled in or paved over, water that would normally soak in and be stored underground, runs right off, and is no longer available to replenish our drinking water aquifers. See pages 205-206 of the *WOW!* book for a more detailed discussion of this function.

A sample data chart for these *Marsh Model* water-holding experiments is provided to help you better prepare for your role in facilitating this activity.

Team Name	Experiment #1 (with sponge = wetland in place)			Experiment #2 (with brick = parking lot in place)		
	Volume Added	Volume Absorbed	Volume Runoff	Volume Added	Volume Absorbed	Volume Runoff

Activity Adaptations

For younger students, these activities can be carried out as teacher-led demonstrations, with students from the class called up to carry out the roles of "rainmaker", "wetland wringer", etc.

Activity Extensions

Sediment/pollution filtering/trapping demonstration: The Marsh Model can also be used to demonstrate the value of wetlands in removing sediments, nutrients and other pollutants from the water. Instructions for doing this are as follows:

With a clean sponge in place in the model, sprinkle a tablespoon of cocoa powder (symbolizing soil particles) over the upland area. Simulate a rain event, by sprinkling 500 ml of tap water over the land. Wring out the sponge into a measuring cup. Although the cloudiness of this wrung out water offers evidence of the filtering function, the layer of dark powder residue left on the sponge is often more obvious to the students.

This experiment can also be repeated with the sponge (wetland) replaced by the parking lot. Students may notice that the water reaching the bay will appear more cloudy under these circumstances than it would with the sponge in place.

To simulate a wetland's capacity for processing nutrients and other pollutants, kool-aid granules can be sprinkled on the model (in place of cocoa) and the experiments repeated in like fashion.

Enviroscape Wetlands Scenario: For those interested in expanding on and enriching such wetlands model-generated learning experiences, we recommend use of this educational resource. Developed by JT&A in Washington, DC (see bibliography for mailing information), *Enviroscape* provides a tabletop model wetlands/watershed laboratory, in which teachers can demonstrate or students perform at least a dozen activities having to do with wetland functions and values, including human impacts of both a negative and positive kind.

A trunk containing the *Enviroscape* wetlands model is available for loan by Wetland Kit-trained teachers in Delaware, by contacting the ARE Center offices.

A rich assortment of related hands-on activities can be found in the new WOW! book. These include:

Water Under Foot (pp. 204-209): explores the connection of wetlands to drinking water aquifers, and identifies improper and proper disposal methods for common hazardous household materials of potential impact to those resources.

Runoff Race (pp. 210-211): provides a simple, but effective demonstration of wetlands' ability to improve water quality by filtering out sediments.

Water Purifiers (pp. 215-219): guides upper level (grade 6-12) students in conducting demonstrations of both natural and mechanical methods of filtering impurities in the water.

Over Hill and Dale (pp. 220-224): students use and interpret topographic maps to chart the course of a waterway, noting sites and land uses along the way that could impact water quality.

Do You Dig Wetland Soil?, How Thirsty is the Ground? and Nature's Filter (pp. 232-252): students explore and compare the physical characteristics and associated functions of wetland and non-wetland soils.

Clean It Up! (Activity #5) in the Delaware Estuary Issues packet (developed by the Delaware Estuary Project, U.S. Fish and Wildlife Service) provides some real pertinent regionally-specific information on water use and its relation to wetlands.

Assessment

Before you do the sediment/pollution trapping demonstrations, challenge your students to think of how the model could be used to show this (or other wetland functions they learned about in Metaphors).

Use the assessment worksheet provided later in this notebook to evaluate your students ability to apply what they learned through these activities.

NAME THAT WETLAND!

Overview

Students work together selecting and using clues to help identify wetland type pictures on an electric quiz board exhibit. The activity features a clue organizer to help keep track of clues, and a scorecard to chart and compare group scores.

Objectives

After successful completion of this activity, students:

- will realize that there are many types of wetlands around them
- will understand that wetland types can be distinguished by several factors, particularly the kind of vegetation growing there
- will be able to distinguish between a marsh and a swamp, and identify some of the other common wetland types featured

Vocabulary

deciduous	marsh	canopy
hardwood	swamp	understory

Skills

analyzing, applying, interpretting, inferring, matching, reading and using information, cooperative learning, creative thinking and problem-solving

Background

What makes a wetland a wetland is subject to a wide variety of interpretations. This is partly because wetlands vary so widely in form and character. Some have water visible at the surface year-round, while others may appear dry for most of the year. Some, like the Everglades, comprise huge expanses of land area, while others, like prairie potholes or vernal pools, can appear as mere puddles of water. Some wetlands, such as our coastal salt marshes, are strongly influenced by salty water from ocean tides, while others are freshwater and fed by groundwater. Some, like the hardwood swamps so common to this region, have trees as the main vegetation type, while others feature grasses and non-woody plants.

Such variations, have contributed to considerable confusion and controversy in delineating, regulating, and protecting these valuable resources. They have also spawned a multitude of classification schemes for wetland types and some complicated sounding terminology for naming them. Words like *palustrine, lacustrine, emergent* and *oligohaline* work well for scientists, but are not a prerequisite for an appreciation of the variety and differences you will want your students to take away from this activity.

For that reason, *Name That Wetland!* uses common names for the wetland types featured, and relies on relatively simple characteristics to identify them. Although the activity does not cover all the wetland types and subtypes in your state, it does feature several of the more abundant, important and special ones, and does conveythe message that we do have a diversity of these resources around us. Maintaining a healthy variety, quality and quantity of these wetland types, as addressed later in the *WetQuest* activity, is of critical importance in meeting the habitat needs of many plants and animals.

The chart on the next page was prepared to help familiarize you with the eight wetland types featured. For further information on wetland types, check out the resources indicated later in this section.

Wetland types of Delaware featured in the *Name That Wetland!* activity*

Type	Description	Typical Plants	Importance	Delaware Examples
salt marsh	in low-lying Delaware Bay/coastal areas, frequently flooded with salt water, fed/dissected by tidal guts/streams, typically with soft, mucky sediments	dense, almost uniform stands of medium to tall *Spartina* grasses; lacking trees, and with few shrubs or other broad-leaved plants	2nd most abundant wetland type in state; provides nursery area for fish/shellfish; and resting areas for migratory waterfowl & shorebirds	along Delaware Bay from Woodland Beach south to The Great Marsh (Lewes)
freshwater marsh	inland or non-tidal low-lying areas with standing water for at least part of the growing season; fed by groundwater or freshwater streams	showing a variety of non-woody plants, including grasses, sedges and various broad-leaved types; (e.g. cattail, arrowhead, etc.)	important habitat for a variety of wetland plants, amphibians, water birds and other species, including the endangered bog turtle	Brandywine Creek State Park; also along several freshwater streams north of the C&D canal
scrub-shrub wetland	associated with stream/river banks; such as along upland edges of salt marshes, beside tidal streams and in the headwaters of mill ponds	features a mixture of short shrubs and small trees, such as high-tide bush, marsh elder, red maple, green ash, and buttonbush	help stabilize stream banks and provide cover for birds and other animals inhabiting these areas	along Spring Creek and Cedar Creek, as well as the St. Jones, Murderkill and Broadkill Rivers
hardwood swamp	inland areas & along river floodplains, water not always visible at surface, but leaf litter appearing blackened from standing water left by rains	featuring a mixture of hardwood (broad-leaved) trees, including: red maple, sweet gum, black gum, willow oak, pin oak, etc.	most abundant DE wetland type (over 130,000 acres); but also the type we are losing most rapidly to housing and other development	throughout the coastal plain and along streams located in the Piedmont region of northern Delaware
Atlantic White Cedar swamp	occurs in poorly-drained, acid, highly organic, soils, along river floodplains; also at the headwaters of mill ponds	features a canopy of evergreens (cedar trees) with a deciduous (maple, gum, etc.) understory; carnivorous plants on forest floor	isolated and relatively scarce, provide critical habitat for several rare plants (including many carnivorous spp.) and animals	mainly in Southern DE; along Cedar Creek, and the Nanticoke and Mispillion Rivers
Bald Cypress swamp	found within forested floodplains of some southern Delaware rivers and creeks; Cypress swamps show standing water	characterized by the presence of its namesake, the evergreen, and knobby-kneed Bald Cypress tree; some maple/gum in understory	The Bald Cypress swamps in Delaware are the northernmost in the U.S., and thus comprise a very special ecosystem for DE	The James Branch near Trap Pond, Trussum Pond, the Great Swamp and six other locations in the state
coastal plain pond	isolated, small, shallow basins, often circular/elliptical in shape, surrounded by woodlands, and appearing dry at the surface for much of the year	perimeter often wooded, but inner zones featuring a variety of low shrubs (e.g. buttonbush) and flowering, herbaceous plants	also called Delmarva Bays or "whale wallows", these wetlands provide critical habitat to several rare plants and amphibians	close to a thousand of these in western, inland areas of state from lower New Castle County through mid-Kent
interdunal wetland	small, damp, freshwater depressions found within and between the inner dunes along the Atlantic coastline	a few clumps of grasses and flowering plants, but largely vegetated with microscopic algae	the algae provides food for fishes and shorebirds using these areas	along Atlantic Ocean from Cape Henlopen State Park south to Fenwick Island

* adapted from: *Saving Wetlands: A Citizen's Guide for Action in the Mid-Atlantic Region*, © 1993, National Audubon Society, Camp Hill, PA

Before the Activity

This activity is one of the more challenging in the kit, so you may want to offer a little pre-activity briefing, in which you impart some basic background on wetland types. This might include the following:

- Nearly half of the clues used in the game to help distinguish wetland types have to do with plants. Consequently, it might help to distinguish some terms associated with vegetation type, including: **trees/shrubs**, **evergreens/deciduous**, **grasses/ broad-leaved plants**; and **canopy/understory**.

- Be sure to apply clues only to the wetland part of the photo, not to the background behind the wetland. For example, one clue for marshes, says trees are not found there, but the photo shows a treeline in the distance well behind the marsh.

- Speaking of trees, ask if anyone knows how to distinguish between a **swamp** and a **marsh**? Few will, but this basic clue will prove helpful: *one type has trees in them and the other doesn't.*

If you can, do the activity *"Wetland Habitats"* (pages 87-92 in the *WOW!* book). Although it doesn't cover all the same wetland types as *Name That Wetland!,* it will familiarize your students with some features to look for while they are playing the game.

During the Activity

The difficulty level of this may put some students off at first, while others will repond to the challenge. Encourage those students who are experiencing difficulty by making any of the following suggestions:

- Acknowledge that this is a challenging activity (even for adults), and encourage them not to get discouraged if they are making wrong guesses. Often times it takes two or even three clues for a given wetland type before you have all the information needed to make a good identification.

- Remind the students to pay close attention to the clues put up by other players, not just the ones they read when it's their turn. Putting the various pieces of information together is the key to success in this activity.

- Remind them also that the goal of the activity is not to score highest or get them all right, but to learn through playing about some wetland types around us. Wrong answers can teach us as well.

Although the instructions for this activity are straightforward (see box below), younger students may need help with how to do the scoring. Since this is a team-oriented activity, the score is computed for the group, not on an individual basis.

Playing:	The idea of this activity is to work together as a team to try to figure out which wetland pictures on the display match up with each of the eight wetland-type names on the lower, center part of the board.
Clues:	The magnetic clue organizer on the right panel contains valuable clues. Whenever you turn over a clue, you reveal a piece of information that can help you match one of the eight wetland types with its picture. Paying attention to these clues will help your team make more correct matches.
Spinning:	Take turns spinning the wheel. The color you spin determines the clues: If you spin ***blue***, turn over any blue (water/soil) clue card on the organizer. If you spin ***green***, turn over any green (vegetation) clue on the organizer. If you spin ***orange***, turn over any orange (miscellaneous) clue card..
Guesses:	No matter which clue color you spin, each turn you get to take one guess. To do this, touch the tip of one probe to the nut head next to the picture and the other probe to the nut head above the name label you think it matches. If your guess is correct, the red light will glow.
Scoring:	Remember: the goal is to work as a team to make as many correct matches as possible in the time allowed and in the fewest total spins. Follow the directions on the scorecard provided to track your efforts.

After the Activity

Ask students to name the wetland types they learned about through this activity. Review the characteristics that helped them distinguish one type from another. Place the exhibit in front of the class and call on students to match the wetland types once again, going over identifying features of each as they do so. Ask: *Do you think you could apply what you have learned to identification of real wetlands in the field?*

There are probably wetlands very near your school or where most of your students live. If a wetland field trip is possible (see Appendix for possibilities), make part of the experience identification of the wetland type and the features that help identify it.

Activity Adaptations

To place more emphasis on using the clues to make "educated" guesses (as opposed to wild guessing), modify the scoring to: deduct 1 point for a wrong guess, add two points for a correct guess, and get 0 points for turns in which no guesses are made.

Activity Extensions

Here are a few other ideas for extending and enriching the learning about wetland types:

Wetland Habitats (pp. 87-92 in the *WOW!* book): If you didn't do this activity as a prelude to *Name That Wetland!,* consider using it for follow-up and reinforcement.

Wetland Type Projects: Divide the class into research teams, assigning each a particular wetland type and challenging them to produce a poster, diorama or other such product illustrating important and interesting features of that type. Use the references listed under "Resources" (many of which are available for loan with the Kit) for additional information about each type.

This Plant Key is All Wet and *Wetland Wheel* (pp. 123-137 in the WOW! Book): Since plants are such an important ingredient in wetland type recognition, these wetland plant identification activities would make for excellent enrichment to the *Name That Wetland!* experience.

Put it on the Map and *Where in the World* (pp. 12-17 in *Wading into Wetlands*): These activities offers a broader (and geographic) perspective on major North American and global wetland types.

Assessment

A series of wetland type photo-transparencies is included with the loan kit for use with the assessment page that follows. This page also challenges students to match wetland types with a set of written clues. If you think either of these activities are too difficult for your students, consider providing them with a copy of the wetland types chart from this section (or some simplified version thereof) to use as reference while making the matches.

Other Resources*

A World in Our Backyard, New England Interstate Water Pollution Commission.This wetland education and stewardship manual is packed with good stuff, including a section (pp. 23-36) on wetland types.

Bridges to the Natural World, New Jersey Audubon Society. Contains excellent descriptions of major habitat types found in New Jersey, including sections on: salt marshes, freshwater marshes, hardwood swamps and cedar swamps.

Our Vital Wetlands, Lake Country Water Authority, Tavares, Florida. An excellent little book with pictures and description of wetland types found in Florida, several of which apply to our area as well.

Wading into Wetlands, National Wildlife Federation's NatureScope series. Includes engaging activities and background sections on several wetland types.

Wetlands of Delaware, Delaware Department of Natural Resources and Environmental Control. Somewhat technical, but provides detailed descriptions of all Delaware wetland types.

WOW!: The Wonders of Wetlands. Environmental Concern Inc. and The Watercourse. In addition to the "*Wetland Habitats*" activity noted above, pp. 10-18, contains good background on wetland types.

WETLAND IQ DELAWARE

Overview

A 4x4 grid board featuring 16 multiple choice questions about wetlands provides the backdrop for this Tic-Tac-Toe-style game. Questions are designed to give students a chance to apply what they have learned about wetland characteristics, values and types, and expose them to additional facts and messages to enhance their knowledge and awareness of national and state wetland issues..

Objectives

After successful completion of this activity, students:

- will be aware of the essential characteristics that define a wetland
- will acquire information about the relative amount of wetlands in their state and which types are most prevalent there
- will comprehend the magnitude and causes of wetland loss both nationally and locally

Vocabulary

development	hydric soils	restoration
degraded	productive	urbanization

Skills

reading and using information, applying knowledge, learning from the mistakes of self and others,

Background

Much of the background and information used in developing the questions/answers for *Wetland IQ* was derived from National Audubon Society's *Saving Wetlands: A Citizen's Guidebook for Action in the Mid-Atlantic Region*. Anyone wishing to learn more about the values, types, history, status, regulation and conservation of wetlands in this region should check out this outstanding resource (a copy is included in the resources tub of the kit).

Before the Activity

Although this activity does not require any initial briefing, you may wish to prepare your students for the fact that much of the material presented here will be new and unknown to them. Except for a few questions about wetland functions and types, it is unlikely that any students will be sure of many answers at first. Let them know that this is OK, that they can think of the game as a pre-test or survey of what they know going in to the activity, and that the more important measure is what they know after they are done playing. Do tell them, however, that by paying careful attention to the incorrect answers (of both self and other players), they will pick up clues that may help them select the correct answers more quickly. Through the process of playing, their *"Wetland IQ"* will increase, along with their appreciation of the value of wetlands.

During the Activity

The difficulty level of this may put some students off at first, while others will repond to the challenge. Encourage those who are experiencing difficulty in the same way you did for *Name That Wetland!* Information on *Wetland IQ* steps of play and questions/answers are provided on the pages following to better prepare you for the activity.

How to Play Wetland IQ
(Two-to-Four Player Version)

This activity gives you a chance to show what you know about wetlands, using a variation on the old Tic-Tac-Toe-type game. Each of the sixteen boxes on the board contains one question card (in gray) and three multiple choice answer cards (in yellow). Critter cards (fish, turtle, frog, and crab) are used to represent the different players or teams. Here's how you play the game:

- ☞ Each player selects one of the four "critter cards" (fish/frog/turtle/crab) to determine his/her team symbol.
- ☞ The order of play (who goes first, second, third, etc.) is: 1st crab, 2nd fish, 3rd frog, and 4th turtle.
- ☞ Each player (in turn), selects a question box, reads the question out loud, looks over the answer choices, then chooses an answer and reads it aloud also.
- ☞ To check his/her answer, the player flips up that card and reads (aloud) the comment printed on the back; this tells whether the guess was right or wrong.
- ☞ If the answer is correct, the player gets to "cover" that square by hanging one of his or her critter cards over the topmost answer wire (covering all answers).
- ☞ If the chosen answer is incorrect, the answers are left uncovered, and the next player may choose that or any other uncovered square to answer.
- ☞ The winner of the game is the first player to cover three squares in a row (horizontally, vertically or diagonally), or, if no one manages that, the person who has the most total squares covered by the end of the game.
- ☞ When the game is over, please remember to place all critter cards back in the pockets in preparation for the next group.

How to Play Wetland IQ
(Single Player Version)

This game can be played by one person, using a simpler (without the Tic-Tac-Toe part) question and answer format. Directions for doing this are as follows:

- ☞ Choose a question on the board. Read it and the three answer choices carefully, and decide on the answer that you think best fits that question.
- ☞ Check your answer by flipping over the answer card you selected, and reading the comment on the back.
- ☞ If your first guess is right, hang a red crab card over the topmost wire (so that it covers all the answers).
- ☞ If our first guess is incorrect, try the question again. Check your answer the same way. If you get it right, hang a blue fish card over the answers. If you get it wrong, hang a green frog card over the answers.
- ☞ Continue like this until you have done all 16 questions.
- ☞ Compute your score, by giving two points for each crab card on the board, one point for each fish, and zero for each frog. Rate your *Wetland IQ* score as follows:

  27-32 You are a real Wetland Wizard!

  21-26 Your W IQ is better than most!

  20-25 Your wetland IQ is average.

  10-19 Your Wetland IQ is so-so!

  0-9 What you know could stand to grow!

- ☞ When the game is over, please remember to uncover all squares to prepare the board for the next player.

Wetland IQ Questions, Answers & Comments (Delaware-version)

The most abundant type of wetland (by acreage) in Delaware today is:

a) coastal tidal marshes
b) forested wetlands (swamps)
c) Delmarva Bays

b) is the answer. DE has 130,000+ acres of swamp-type wetlands. Coastal marshes are 2nd (90,000+ acres). Delmarva Bays are many in number but small in size.

From the mid-1950's to mid-1970's, over 11 million wetland acres were lost in the U.S., mostly due to:

a) draining and filling for farming
b) urban development
c) mosquito control

a) is the answer. Although urbanization has contributed to coastal wetland loss, overall almost 10 million of those 11 million acres were lost through conversion to farmland.

Which of Delaware's counties has the most acres of wetlands?

a) New Castle County
b) Kent County
c) Sussex County

c) is the answer. Approximately 44% (about 98,000 acres) of Delaware's wetlands are in Sussex County.

In order to grow well in wetlands, plants need to be able to live and grow in soils having little or no:

a) water
b) nutrients
c) oxygen

c) is the answer. Because of their waterlogged nature, there is little room for air in most wetland soils.

The greatest cause of wetlland loss in Delaware today is from:

a) agricultural activity
b) residential development
c) sea level rise

b) is the answer. Demand for new homes is a major cause of wetland loss today, especially in wooded wetland areas. In the past lots of wetlands were converted to farmlands, but laws today prohibit this.

Which law is largely responsible for regulating and protecting wetlands at the federal level?

a) The Endangered Species Act
b) The Clean Water Act
c) The Coastal Zone Management Act

b) is the answer. Although many endangered species live in wetlands, Section 404 of the Clean Water Act is the federal law under which wetlands are regulated. The Coastal Zone Act is important also, but at the state level.

What percentage of Delaware's total land area today is wetlands?

a) 18 %
b) 36 %
c) 54 %

a) is the answer. That amounts to almost 223,000 acres of wetlands. In the 1700's, there were twice that many.

Wetlands are valuable in that they:

a) provide habitat for many birds, fish & other wildlife
b) absorb and hold water in times of flood & drought
c) improve water quality by filtering sediments/pollutants

This is a freebie, because all of the choices are correct. Wetlands provide these and many other benefits to humans and the environment.

Which wetland type is being lost most rapidly in Delaware today?

a) Cypress swamps
b) coastal marshes
c) forested wetlands

c) is the answer. Loss of inland, wooded wetlands, especially from new housing developments, is the biggest area of loss. Thanks to Delaware's Coastal Zone Management Act, and the considerable acreage that are under state and federal ownership, the outlook for conservation of our coastal marshes is much brighter. Although there are only nine Cypress swamps in Delaware, most of these are state-owned and not in danger of being developed.

Which of the following statements most correctly describes the wetland situation in the U.S. today?

a) Because not all wetlands are protected, we are still losing large amounts of wetlands every year.
b) Thanks to tough new laws and regulations, we are no longer losing wetlands in the U.S.
c) Because of wetland restoration and construction, we are actually gaining more wetlands every year.

a) is the answer. Although rate of loss is not as bad today, over 500,000 wetland acres are still lost in the U.S. each year. Although restoration cannot add wetlands, it does try to undo some of the damage done to degraded ones.

Wetland IQ Questions, Answers & Comments (Delaware-version) cont'd	
About what part of our country's original wetlands have been lost? a) a third b) a little more than half c) three-quarters b) is the answer. This fraction applies to Delaware as well, where over 200,000 acres of wetlands have been lost.	Wetlands are partly defined by the presence of "hydric" soils. This means that these soils: a) lose water very slowly b) hide a rich supply of oxygen c) hold water and release it slowly c) is the answer. Hydric means "water-holding"; wetland soils tend to drain very slowly.
To be called a wetland, a piece of land must be covered by water: a) some of the time b) most of the time c) all of the time a) is the answer. Some of our most valued wetlands (for rare and endangered species), such as coastal plain ponds, are only underwater for a small part of the year.	Acre for acre, which of these places would support the greatest growth of plant material in a year? a) an Iowa cornfield b) a Delaware Bay salt marsh c) a rainforest in the Amazon b) is the answer. Salt marshes are among the most productive ecosystems on the planet, producing more plant growth than the most heavily fertilized farm fields.
Which of the fifty states has the greatest amount of wetlands? a) Alaska b) Florida c) Delaware a) is the answer. Alaska has more land in wetlands (over 200 million acres) than all other 49 states combined! Though Delaware ranks fairly high in percentage of land in wetlands (18%), in total area we our low on the list.	The difference between a 'swamp' and a 'marsh' is that swamps: a) have many dangerous animals b) have more water at the surface c) have lots of trees in them c) is the answer. Swamps are defined by the presence of trees, while marshes have more grassy vegetation. Both swamps and marshes vary widely in the amount of water visible at the surface.

Activity Adaptations

Wetland IQ can also be used individually (see game instructions for one player version). The board is designed so that new sets of questions/answers can be added in the future, either targeted for different grade levels or focussing on other topics.

Assessment

The assessment sheet provided is designed to follow up on information and concepts presented in the *Wetland IQ* question and answer content. This could also be used as a pre/post assessment tool for evaluating the effectiveness of this activity.

Activity Extensions

After all students have completed all the Wetland Kit activities, ask them to develop *Wetland IQ*-style questions and answers covering other things they learned from doing the activities. The best of these questions could be developed into a class follow-up activity or quiz (e.g. using 3x5 *Post-its* for attaching Q's/A's to the game board).

Other Resources

What's Your Wetland IQ? (pp. 53-58 in *Wading into Wetlands*) provides a good source of additional wetland- trivia-type questions.

WetQuest Delaware

Overview

A cartoon-style map of Delaware, with push pins designating twelve selected map sites, serves as a backdrop for this interdisciplinary matching activity. Two clue sets - one combining geography, natural history, and historical information, and the other associating threatened, endangered or otherwise important species with wetland habitats - are provided.

Objectives

After successful completion of this activity, students:

- will be able to associate different wetland types with specific locations within the state
- will recognize "key spots" for interesting and important natural and cultural history events associated with Delaware aquatic habitats
- will become familiar with the habitat types and status of selected wetland animals
- will understand that diversity of habitat types is needed for maintaining diversity of life forms

Vocabulary

endangered	threatened	rare
habitat	biodiversity	rookery

Skills

analyzing, applying, inferring, matching, reading and using information, and geographic/map-reading skills.

Background

Despite its small size, Delaware features an amazing abundance and variety of aquatic resources. Prominent among these is one of the busiest river/estuary systems in the country, the Delaware, which traverses the length of the state for over 100 miles of shoreline. Along its path, from freshwater in the north to its estuarine mouth at the ocean, it: provides habitat for over forty commercially and recreationally important fisheries (including history-rich traditions in sturgeon, shad, menhaden, oysters and others), features an Inland Bays area of hundreds of acres of biologically-rich sheltered, estuarine habitats, supports the largest population of horseshoe crabs on the planet, and is recognized as a Shorebird Reserve of International Importance.

This richness of Delaware's River/Bay/coastal plain resources extends to, and is interdependent with, the wealth of wetland resources found in the state. These wetlands cover over 220,000 acres, or 18% of the state's land area, divided among at least a dozen recognized wetland types. Included among the latter are thousands of acres of protected coastal salt marshes, the northernmost Bald Cypress swamps in the country, and large concentrations of ecologically-special coastal plain pond habitats.

This diversity and abundance of wetland types is in turn tied to the abundance and variety of animals that live, feed and breed, shelter and grow their young, rest and refuel during migrations, or otherwise use these habitats to carry out part or all of their lives. At the national level, nearly 75% of our endangered or threatened birds, 25% of our plants, and 50% of all species overall, depend on wetland habitats - despite the fact that these habitats make up less than 4% of our land area. In Delaware, a recent list from The Natural Heritage Inventory identified over 250 animals and 300 plants as "species of special concern" that are associated with wetlands. The underlying message in all this is that we need to conserve our wetlands richness and variety in order to maintain the diversity of life forms they support.

Before the Activity

This activity requires little pre-activity orientation. It may help students to know that, depending on where they have been in the state and what they may know (or not know) about Delaware's "wet" features, the clues may prove to be easy or difficult to them. That's OK, because if careful attention is paid to what the clues say, and what the map shows, at least some matches can be "figured out" without prior knowledge or experience. For those who really use what's provided, there is a chart on the lower left panel, with information relevant to the site clues. Notice that this is not advertised anywhere in the instructions, so players are rewarded for discovering and making use of this on their own.

During the Activity

The second set of clues, associating critters with map sites are going to be tougher for most students, so feel free to offer some extra tips as you circulate. Although a few of the critters clued do appear on the map, for the most part they don't, so students need to "read into" the clues, for geographic, wetland types, or other information that might help them correctly place the critter on the map sites. It's also important to point out, if not here, then in the follow-up to the game, that in real-life, many of these animals can be found at several different habitats/sites within the state; for simplicity's sake, the clues have been constructed so that each animal is associated with a particular location.

WetQuest Instructions (Part One)

In this activity you try to match selected aquatic habitats in Delaware with important events occurring there. Steps of play are as follows:

1. Each player in turn shakes out a numbered chip from the cup (to start: high number goes first, next highest second, etc.).
2. Select the yellow clue (from the 12 hanging below) that matches the number of the chip you drew.
3. Say the letter of the map pin location you think fits this clue.
4. Check the back of the card to see if this is a correct match. If not, return card to board and chip to cup, and await next turn
5. If it matches, hang that card from the map pin it matches, and keep the chip as a token showing that you got that site right.

Continue taking turns like this until all yellow clues are properly placed on the map. The player with the most chips at that time wins this part of the game. If time allows, move on to the critter card part of the game (described on the top of the right panel).

WetQuest Instructions (Part Two)

In this part of the game, you try to match critters with map locations. There are some differences in the steps of play, so read carefully:

6. All players hold on to their chips from the first part of the game. Player with the most chips goes first, next most second, etc.
7. Choose a gray critter clue (from those hanging below) that matches the number of one of your chips.
8. Say the letter of the map pin location you think fits that clue (note: critter numbers may not match event number locations!).
9. Check back of card to see if correctly matched. If not, return card to board, and give chip to player whose turn follows you.
10. If it matches, hang that card from the map pin it matches, and turn your chip number side down to show that you got it right.

Continue playing until all clues are properly placed on the map. The player holding the most chips at the end is declared winner. Please be sure to replace all cards and chips for the next group!

Map Key	Delaware Location & Habitat Type	Site Clues & Information	Critter Clues & Information
A	Pea Patch Island on the Delaware River (also the location of Fort Delaware State Park)	**10** *This site of a former Union Civil War prison now serves as a rookery* (largest on the East Coast north of Florida) *for 1000's of pairs of nesting wading birds.*	**8** *The* ***glossy ibis*** *... is one of thousands of wading birds that nest in trees on this ... island each spring.* Others include: Great blue herons, black-crowned night herons, snowy egrets and cattle egrets.
B	Thousand-Acre Marsh, south of the C & D Canal (featuring large area of freshwater marsh habitat)	**3** *Dudley Lunt wrote a book* (entitled Thousand Acre Marsh) *about this large wetland bordering the C &D canal.*	**7** *The now endangered* ***bog turtle*** *was once found along the wet meadow edges of this large fresh-water marsh area.* Draining/destruction of wet meadows and marshes, and illegal collecting for sale have led to the decline of this species.
C	Blackbird Forest, state forest area having a large concentration of coastal plain ponds (also called Delmarva Bays)	**6** *Woodland ponds like this are also known as "whale wallows", and are much smaller* (mostly less than half an acre in size) *and more numerous* (there are hundreds in DE) *than shown here.*	**2** *Often heard, but seldon seen, the* ***barking tree frog****inhabits these coastal plain pond habitats in DE.* This critter is on Delaware's endangered list, and depends on coastal plain pond habitats for survival; gives loud "barking" rain chorus from high up in trees.
D	Bombay Hook National Wildlife Refuge, part of large area of protected coastal salt marsh habitat	**11** *This area encompasses 1000's of acres of ... protected coastal marshlands, and some of the most prime waterfowl watching spots in the Mid-Atlantic.*	**5** *The* ***rare skipper*** *lays its eggs on big cordgrass plants growing in brackish marshes along DE Bay.* This little brackish-marsh-dependent butterfly is ranked S1, for extremely rare, in Delaware.
E	Legislative Hall, State Capitol (politician habitat)	**9** *Work done in this place is of critical importance to the future protection of Delaware's wetland resources.*	**1** *The fascinating behavior of the adaptable animal,* ***homo sapiens****, subspecies politicia, is best observed here.* This species is not endangered!
F	Norman G. Wilder Wildlife Area, featuring Delaware's most widespread wetland type, the hardwood swamp	**4** *Much of the deciduous forest lands in Delaware, including this patch here, are classified as wetlands.*	**11** *Large hollow trees in wet forests provide critical habitat for this nocturnal predator, the* ***barred owl****.* This S2-ranked (very rare in DE) raptor relies on mature floodplain forested wetlands for survival.
G	Slaughter Beach, Delaware Bay, one of several DE Bay/Estuary beaches in this stretch of shoreline.	**1** *This is one of the peak places where horseshoe crabs have gathered in DE Bay to spawn for millions of years.*	**10** ***Red Knots*** *are one of twenty species of shorebirds that stop here to feed on horseshoe crab eggs on their 6000-mile annual migration.* DE Bay provides vital rest/refuel habitat for these birds spring migrations from Argentina to the Arctic.
H	Cape Henlopen State Park, featuring northernmost Atlantic Ocean beaches in the state	**7** *This large state park has beautiful beaches, the Seaside Nature Center, and some of the most spectacular dune areas on Delmarva.*	**12** *Parts of the beach here are closed to protect critical nesting habitat of the now endangered* ***piping plover****.* In recent years, only a handful of nests of this rare species have produced fledglings.
I	Cedar Creek wetlands (near Milford Neck), featuring rare Atlantic White Cedar swamps	**12** *Atlantic White Cedar trees are the habitat highlight of this rare and very special place.*	**4** *The rare* ***four-toed salamander*** *lays its eggs in thick mounds of peat moss in these coastal plain cedar swamps.* Though not listed on DE's endangered list, this cedar swamp dependent species is considered extremely rare in the state.
J	Indian River Bay, largest of four Inland Bays in state, featuring fertile, shallow, sheltered estuarine habitat	**8** *Fishing, crabbing and clamming are popular activities in the Inland Bays area of the First State.*	**6** *The once-imperiled* ***diamondback terrapin*** *often gets trapped in crab pots in these busy saltwater bay areas of southern Delaware.* Scientists are trying out Turtle Excluder Devices (TED's) to allow terrapins to escape crab pots.
K	Trap Pond State Park, home to the northernmost Bald Cypress swamp in the United States	**2** *This scenic park offers beautiful spots to hike and canoe in the midst of centuries-old cypress trees.*	**9** *The small, but attractive,* ***black-banded sunfish*** *swims the dark-stained waters of these cypress-shaded swamps.* This is one of three kinds of pygmy sunfishes (adults only reach 3-4" in size) found in Delaware's swamps, ponds and streams.
L	The Nanticoke River, one of two Delaware rivers that flow into the Chesapeake, featuring some cedar swamp wetlands along its banks	**5** *This body of water may be part of Delaware, but it actually drains into the Chesapeake Bay.* The Choptank is the other Delaware river that flows west to the Chesapeake.	**3** *The little-known* ***harlequin darner*** *lives and breeds in Atlantic White Cedar Swamps located along this Chesapeake Bay tributary.* This is one of the rarest of nearly 100 species of dragonflies known to inhabit Delaware wetlands.

After the Activity

With the *WetQuest* board open in front of the class, review with the class some of the things they discovered about the map sites identified. As you go over each site, poll students to see who has been to any of these places, and allow those who have to relate things they saw, learned or experienced there. Or alternatively, call on students to come up and identify key "wet places" on the map (such as the C&D Canal, Inland Bays area, etc.) and relate what they learned about each.

Since one of the goals of this activity relates to recognition and reinforcement of wetland types (as relates to the *Name That Wetland!* activity), also ask students to identify these wetland types on the map:

Freshwater marsh	Salt marsh
Coastal plain ponds	Cedar swamps
Hardwood swamps	Cypress swamps

Turning attention to the "critter clues" part of the activity, ask students for ideas on what they thought the point of this was. The obvious answer - to learn about some of the animals that live in Delaware wetlands and associate them with particular areas - will come first and in many forms, but encourage them to think further (with nudging if needed) toward some larger ideas. One of these is that different animals (and plants) have different habitat needs. Another (which is more or less a corollary to this), is that the more kinds of these wetland habitats we can conserve, the greater variety of plants and animals (termed **biodiversity**) will be supported.

This leads to the question: *Why are so many wetland animals listed as endangered* (species considered in danger of extinction) *threatened* (species likely to become endangered in the foreseeable future if current trends are not reversed) *or species of special concern* (species that are otherwise considered rare either because populations are small or restricted to a limited area or habitat type)? The answer has much to do with loss of habitat, both from past destruction of wetland areas, and present patterns of habitat fragmentation (smaller pieces are being lost, resulting in isolating/reducing habitat areas to a size below what is needed for a species to survive and reproduce). Ask students to think of reasons for such habitat loss. See the *Quack, Quack, Human Impact* section of this manual for background/ideas relating to such a discussion.

Activity Extensions

What is Habitat?: Activity 6 in the *Delaware Estuary Issues* packet provides excellent background and discussion material on habitat issues.

Creature Features: Assign students to research one of the wetland animals featured in the game, as part of a class project/production of a "special species" magazine. Components of each creature's page could include: where it lives, both geographically and by habitat type, what its status is (endangered, threatened, etc.) both in Delaware and nationally, what past conditions have contributed to its status, what problems it faces in terms of future recovery, and any other neat stuff (how it lives, feeds, migrates, etc.) you can find. In addition to the animals featured in the game, other wetland critters suitable for this project may include the: bald eagle, osprey, harrier, brown pelican, spotted salamander, Eastern tiger salamander, and redbelly watersnake.

Dress the Dragonfly: Challenge students to this wetland modification of the classic "hangman" game. Think of one of the twelve *WetQuest* critters, and challenge the class to ask careful "yes" or "no" answerable questions that will help them deduce the identity of the critter. Each "no" answer results in addition of one dragonfly body part to the drawing, starting with the head/eyes, then thorax, abdomen, six legs and ending with the front and hind wings. Encourage them to pose questions that take into account habitat areas from the map, as well as the more obvious "what type of critter is it?" clues.

Miscellaneous Ideas: Call on students to locate (as closely as possible) your school, town, or any other areas of interest, on the map. Discuss what types of wetlands appear to be in the vicinity (making sure students realize that the map is an exaggerated, cartoon-version of reality). Alternative clue sets could also be developed for use with the map, to focus on other geographical locations and details.

Assessment

Challenge students to plan a "dream" field trip that would take them to the three (of the twelve) locations on the map they would be most interested in visiting. Their written "proposal" should include why they choose these places and what they would hope to do, see and learn when they got to each.

WETLAND CAFETERIA

Overview

Students work together to construct a wetland food web using plastic chains to connect objects and organisms on an a poster of a Delaware Bay salt marsh. A set of 44 rhyming "food chain event cards" provide the clues that define the connections.

Objectives

After successful completion of this activity, students:

- will identify some plants and animals common to Delaware Bay salt marshes
- will acquire an understanding of the food chain connections that link the various components of the marsh ecosystem
- will recognize that plants provide the primary food base for wetland life, either directly, by way of animals that consume the living plants (and are in turn eaten by other animals), or indirectly, through energy transferred by the decay of dead plant material (detritus)

Vocabulary

algae	carnivorous	scavenger
diatoms	herbivorous	phytoplankton
detritus	omnivorous	zooplankton

Skills

observing, classifying, identifying, inferring, reading and using information, and cooperative learning

Background

The tidal marshes bordering both sides of Delaware Bay are among the most biologically productive and ecologically interesting places on the planet. The combination of tidal exchanges, nutrient-rich soils, and energy cycles involving intense seasonal growth and decay of marsh grasses, all interact to create a complex "soup of life" of astonishing productivity.

The grasses responsible for making the salt marsh such a productive place are largely those belonging to a group known as the *Spartinas*. These grasses grow incredibly fast, producing more green growth (175 pounds of plant material per acre per day) than our most heavily fertilized farm fields. Nearly all of the animals in the marsh (and many of those in the estuary) depend in some way on this *Spartina* growth for nutrients and energy. Although this includes animals, such as grasshoppers, snails, muskrats and rabbits, that feed directly on the living plants, for most marsh animals, *Spartina* is most valuable as a food source only when it dies back and is broken down into bits and blobs of decaying material called **detritus**. Awesome populations of bacteria are at work in marsh mud doing the work of decomposing *Spartina* stems and leaves, making the energy in them avaliable to small detritus feeders like grass shrimp, mud snails and fiddler crabs, which in turn nourish the fishes, birds and other large life forms that live and feed in the marsh.

The cycle of *Spartina* growth and decay can be likened to a giant storage battery for marsh energy and nutrients. In the spring and summer, as *Spartina* converts sunlight to green growth, the battery is in a "charge-up" mode; in the fall and winter, as *Spartina* dies back and decays, the stored energy is released, as the battery slowly discharges its abundant energy reserves. In this way, *Spartina* grasses provide a rich and steady diet of food to fuel the marsh food web year-round.

For more information on salt marsh ecosystems and food webs, see pages 109-110 of the *WOW!* book.

Before the Activity

Although students need no prior briefing to do *Wetland Cafeteria*, some exposure to basic food chain/ecosystem concepts would be beneficial (producers, consumers, decomposers, plankton). Since some of the rhymes contain words that will be new to many students, you may wish to go over the vocabulary (above) ahead of time, or alternatively, ask your students to write down any new words encountered as they play, with an eye towards going over them in the follow-up session.

Depending on the ability of your students, consider challenging them to write down what they think each new word means, based on their impressions of the context in which the word is used.

Since this activity focusses on salt marshes, find out what your group knows about these environments. *Has anyone ever been to or seen a salt marsh? Where are they found? What's special about them?*

The 2nd segment of *"The Living Tidal Marsh"* video provides good background on salt marsh food webs.

How to Play Wetland Cafeteria

- ☞ take turns picking a rhyming clue card from one of the pockets in the lower left panel (each card describes a food chain event involving two parts of the marsh community)
- ☞ use the drawings on the back of each card to locate those two objects on the poster
- ☞ select a piece of chain from the right panel long enough to connect the two objects (the color mark at the end of the chain piece should match the dot on your card)
- ☞ loop each end of the chain over the cup hook that belongs to each of the food event objects you are connecting
- ☞ keep taking turns doing this until time is up or all clue cards have been used
- ☞ step back and marvel (for a moment) at the food web you have constructed!
- ☞ please return all chains and cards to their starting positions for the next group

After the Activity

Use questions such as the following to review the basic food chain components, asking students for examples of each from the salt marsh ecosystem:

- *Where does the energy come from that starts the whole food chain?* (the sun)
- *What are producers? What is their role in the ecosystem?* (green plants, algae, phytoplankton)
- *Who are the consumers?* (contrast herbivores, carnivores and omnivores)
- *What part of the food chain haven't we mentioned? (*emphasize the role of detritus and the decomposer part of the marsh food web).

Most grade 4-8 students will be familiar with the producer-herbivore-carnivore aspect of food chains, but the decomposer part of the cycle is generally not as well known. In many aquatic ecosystems, including salt marshes and woodland streams, a large part of the food base is not derived directly from consumption of living green plant material, but rather from energy and nutrients released through the decomposition of dead plant and animal matter. Microorganisms play a key ecological role in this process in two ways. Firstly, the energy they collect from "eating" the detritus" is passed on to larger organisms that consume the microbes; and secondly, in the process of breaking down the dead stuff, they release nutrients back into the water that green plants can utilize for further growth.

The chart on the page following summarizes the food chain connections represented in the activity.

Food Chain Connections Featured in *Wetland Cafeteria* (associations are presented for only those connections featured in the activity; in real-life, many other food chain connections would exist)

Plant or Animal	Gets Energy From	Provides Energy To
cordgrass	sunlight	muskrat, deer, detritus
salt hay/giant reed		marsh mouse
sea lettuce/glasswort	sunlight	
eel grass	sunlight	black duck
flowering aster	sunlight	butterfly
algae/diatoms	sunlight	mud snail
phytoplankton	sunlight	zooplankton, menhaden
zooplankton	phytoplankton	mosquito larvae, killifish, white perch
grass shrimp	detritus	white perch
mud worm		shorebird, bullhead
ribbed mussels	detritus (in water)	
mud snail	diatoms, detritus	
fiddler crab	detritus	terrapins, rail
blue crab	mummichugs	blue heron, human
midge larva	detritus	bullhead
mosquito larva	zooplankton	mummichugs
mosquito adult		dragonfly
greenhead	human	dragonfly
dragonfly	mosquito (adults) and greenhead flies	
butterfly	flowering aster	blackbird
ladybug		marsh wren
mummichug	mosquito larvae	blue crab
bullhead	mummichugs, worms, midge larva	detritus
killifish	zooplankton	snowy egret
menhaden	plankton	great egret
white perch	zooplankton, grass shrimp	human
eel		terrapins
diamondback terrapin	fiddler crabs, grass shrimp	eel
black duck	eelgrass, mud snails	
rail	fiddler crab	
shorebird	mud worms	
snowy egret	killifish	
great egret	menhaden	
blue heron	blue crab	
red-winged blackbird	butterfly	
marsh wren	ladybugs	raccoon
marsh hawk	mouse	
marsh mouse	giant reed, salt hay	marsh hawk
muskrat	cordgrass	human
deer	cordgrass	human
raccoon	wren eggs	
human	mosquito, greenhead	blue crab, muskrat, deer, white perch

Activity Adaptations

The pictures provided on the back of the food chain event cards are there to help students identify the creatures to be connected on the board. To make the game more challenging (and add a competitive element) students could be asked to try to make the connections before looking at the back of the card. If they guessed correctly, they hold on to that card as a token that they got it right. If one or both of the objects connected are incorrect, they put the card on the bottom of the deck and defer to the next player. The winner is the player holding the most cards when the rotation is over.

Activity Extensions

There are a greater number and variety of resources available on food chains/webs than any other activity featured in this kit. Here are ten that we've culled from various places (most of which are provided in the kit's supplementary resources tub).

The Living Tidal Marsh If you didn't view this video as a prelude to *Wetland Cafeteria*, it's a good way of making what they did in the activity more "real" in the follow-up. The activity book that accompanies the video also has some good information for reinforcing the learning.

Changing with the Tide: The National Wildlife Federation's *Wading into Wetlands* activity book features two activities dealing with salt marshes. One involves an "outdoor-active" activity in which students role play low marsh/high marsh events, and the other features ideas for creating a salt marsh critters display board.

Marsh Market is a two-part WOW! activity (pages 109-115) that engages students in constructing a living food web (using a ball of yarn or string), then using the components of their lunches to create their own food web.

Salt Marsh Players (pages 165-173 in WOW!) uses role-playing to teach students about the tidal cycle, and creatures adaptations to it.

Food Web Detective is a deskwork/homework type food web learning activity provided on the back page of the *Ready, Set ... Get Wet!* handout available from the Natural Resources Conservation District.

Energy Flow in a Wetland This poster-based board game, available from the National Science Teacher's Association, offers a quantitative view of the transfer of energy from one organism to the next in a freshwater marsh system.

Marsh Math (from the *Estuaries & Tidal Marshes Habitat Pac*) challenges students to follow the movement of nutrients through a marsh food web.

Marsh Munchies (pp. 192-198 in *WOW!*) is another neat activity that brings math into the food web scene. It involves the students in role playing (indoors or outdoors) various activities and events in the life of a muskrat, and using this information to calculate its energy requirements.

They all have to make a living and *Who's Who, and Who Eats Whom?* (Activities 2 and 3 from the Delaware Estuary Issues packet) provide some interesting and close-to-home perspectives on food webs in the marsh/estuary, including an activity called "*Wiring Diagrams*" that challenges students to create different kinds of food chains based on a list of organisms/feeding preferences.

Marsh Mystery (pages 116-119 in *WOW!*) and *Plight of the Peregrine* (pages 237-239 in *Keepers of the Animals*) both address the issue of biomagnification of pollutants through the food chain, which offers an ecologically-meanngful extension to the food web learning started here.

Assessment

Challenge groups of students to select other types of wetland ecosystems (e.g. hardwood swamp, freshwater marsh or bog), research the plants and animals living there and develop a food web drawing or poster illustrating some of the connections. For language arts enrichment, invite students to create food chain rhymes similar to those developed for *Wetland Cafeteria*. As for the other activities, a worksheet assessment is provided in the Appendix.

Other Resources

Most of the resources alluded to under the Extensions section above feature good background information on salt marsh/wetland food web and ecosystem concepts. For a more in-depth appreciation of the salt marsh environment, read John and Mildred Teal's *Life & Death of a Salt Marsh*.

BUILD A BIRD

Overview

Given a box containing body, head and leg parts for 12 kinds of wetland birds, students are challenged to interpret clues about where, how, and on what, a bird feeds and "build the bird" those clues describe. The parts are coded so students can check the accuracy of their constructions after the fact.

Objectives

After successful completion of this activity, students:

- will learn that many different kinds of birds live and feed in wetlands
- will understand that the bills of birds show many kinds of adaptations to feeding on the various types of foods found in wetlands
- will recognize some of the ways that the feet and legs of wetland birds help them adjust to life in various wetland habitats
- will become familiar with the feeding habits, appearance, and habitat preferences of 12 common Delaware Estuary wetland birds

Vocabulary

adaptation	dabbling ducks	perching
shorebirds	diving ducks	talons

Skills

reading and using information, visualizing, creative problem-solving, trial & error learning, manipulating materials, and cooperative learning

Background

Wetlands offer a wide variety of habitat and food conditions to support many kinds of living things. Prominent in this web of wetland life forms are the birds, both in terms of the numbers and kinds that use wetlands, and in the remarkable array of adaptations they display for life in the water/mud world.

Hundreds of bird species use Delaware Estuary wetlands, including many migratory species that stop here at various times to rest and feed and others that live here year-round. In addition to the tendency of different birds to use these habitats at different times (depending on the timing of north/south migrations), a key factor in this diversity lies in the adaptations that have evolved to enable different species to utilize different kinds or parts of habitats available.

For example, wading birds, like the snowy egret, have long legs adapted for feeding in deeper water while a bird like the kingfisher (that dives into the water to catch its food) has short, strongly clawed-legs for perching on tree limbs along the riverbanks. Or contrast the legs and feet of diving duck types (legs set back on the body, with a long rudder-like back toe adapted for diving deeper in ponds/lakes) versus those of the shallow-water, upside-down feeding dabbling ducks (legs set nearer the middle of the body and with a less prominent back toe).

Even more amazing are the variety of adaptations birds have evolved for taking advantage of the rich and varied food resources available in wetlands - a feature illustrated by the remarkable assortment of beak structure variations evident in wetland birds. From the short, straight, strong beaks of seed-eating birds like the cardinal, to the broad, deep-pouched bill of the fish-eating pelican, to the long, slender curving bill of many mud and sand probing shorebirds, the shape and size of a birds beak is closely related to what, where and how it eats.

Before the Activity

Prior to letting students loose on *Build-a-Bird*, we would ask that you please take a few minutes to make the following safety-related suggestions:

- Some of the parts they will be tinkering with are sharp, and if not handled carefully could cause injury. This is especially true of the pewter feet. Hold up some of these parts and ask the students to think of potential areas of concern (legs poking in the eye, breaking of beaks, etc.). *Caution them to handle these items with utmost care!*

- Also point out that, due to differences in the size and spread of legs, only certain ones will fit comfortably in the bodies. If one tries to force a fit that isn't meant to be, the legs may break or become bent out of position. If one experiences difficulty getting a set of legs to fit, chances are that it is not going to be the right match!

For adaptation-related activities to use before doing *Build-a-Bird*, check out the resources listed in the "Extensions" section.

During the Activity

This activity seems to bring out a "free-lancing" approach in many students, both in terms of working independently and breaking away from the instructions, clue cards, etc. This may not be a bad thing, especially if students are truly trying to construct birds that are structurally, functionally and ecologically sensible. You may need to remind a few students of this, as some can get caught up in constructing combinations based more on silliness than on paying attention to the clues presented.

Other students may need some help relating what the clues tell to what the parts show. Some well-placed questions could help here, such as: "*What kind of feet (webbed or separately-toed) do you think would be better for walking on land? Which would be more useful for swimming or diving?*" or "*If you needed to probe deep in marsh mud for food, which bill type would work best, long and skinny or short and fat?*" As always, encourage the students' efforts to think the clues through, regardless of whether their first guesses turn out to be the correct. See the chart on page 41 for more information.

Build-a-Bird Instructions

Many sizes, shapes and varieties of birds live in and around wetlands, each uniquely adapted in body and behavior to do so. This activity introduces you to some of these birds, and challenges you to explore their adaptations for feeding and living in wetlands.

- ☞ Choose a Build-a-Bird Challenge Card from the deck. Read the clue carefully and think about what it says about the type of body/bill/feet this bird might have.

- ☞ You need to assemble the right combination of head, body, and leg parts to build your bird. You can start anywhere, and try out as many parts as you like, but will have a better chance of being successful sooner if you pay close attention to the clues!

- ☞ Whatever the part, sort through the choices for the one you feel best fits all the clues. Don't worry if you're not sure at first, you can always go back later and readjust.

- ☞ Once you think you've got it right, check your efforts for accuracy using the codes printed on the back of the clue card. Heads and bodies are coded by letters written on the under-side of each; legs are coded by reading the colored pattern of bands.

- ☞ You can also check your efforts by comparing your bird to the drawings on the box lid. Once you're all done checking and correcting, feel free to try another ... and another.

Information on Wetland Bird Adaptations included in the *Build-a-Bird* Activity

Bird Species/Type	Bill/Head Adaptations	Leg/Feet Adaptations	Other Features
Seaside Sparrow (songbird)	short and stout bill adapted for cracking seeds	short, thin legs, with long, curved claws adapted for perching on vegetation	can be found flitting and hopping near the ground in grasses and shrubs
Marsh Wren (songbird)	moderately long, slender bill adapted for catching and eating insects in the marsh	short, thin legs, with long, curved claws adapted for perching on vegetation	this active little bird holds its tail upright as it hops from stalk to stalk in the marsh
Kingfisher (songbird)	long, strong, sturdy beak used to hold fish that it catches by diving headlong into the water	very short, stubby legs for body, with finely-curved claws for grasping on to branches overlooking the water	frequents stream/river edges where it nests in the banks and perches on tree limbs near the water's edge
Harrier (bird of prey)	short, strong, hooked bill adapted for tearing the flesh of small mammals	legs strongly muscled for carrying off prey; with sharp, curved talons for grasping	a common sight soaring and gliding low over Delaware Bay salt marshes
Snowy Egret (wading bird)	long, S-shaped neck, with strong, pointed beak adapted for spearing fish, crabs and other marsh critters.	legs long, with three-toed feet, for wading the wetlands where it likes to do its fishing; feet bright yellow in color	herons and egrets have been known to drop leaves, sticks and other objects in the water to attract fish
Oystercatcher (shorebird)	strong beak is deeper than wide, and narrowing to head, adapted for prying apart oysters and other shellfish	fairly long, and strong legs for wading out into the intertidal zone where the clams it feeds on are found	the sideways skinniness and flatness of the beak enable it to pry off shellfish rocks attached to rocks
Yellowlegs (shorebird)	long, slender, slightly down-curved shorebird bill, adapted for probing the marsh mud or sand for small invertebrates	long, skinny yellow legs adapted for running quickly along the tide line and for shallow wetlands wading	a very common bird along mud flats of tidal streams and coastal marshes
Virginia Rail (ground bird)	beak broad, moderately long, tapering, and slightly down-curved, adapted for probing marsh mud for fiddler crabs	body and legs somewhat chicken-like, with long back-pointing claw on feet for digging around in the ground	secretive inhabitant of the upper to lower marsh; feeds on small crabs and fish along the tidal flats
Laughing Gull (beach bird)	beak fairly broad and flat (compared to shorebirds), and flattened on the bottom for slurping water	differs from shorebirds in having webbed feet, which are well-adapted for both swimming and walking	learn to pick up and drop shellfish from on high and then feast on the soft parts inside the broken shell
Merganser (fishing duck)	bill unique among ducks in having saw-toothed margin, good for grasping small fish that it catches while diving	typical webbed, paddle-style duck feet, which, along with slender body shape, adapts it well for swimming and diving	most mergansers have head crests, which give the birds a "punk-hair-do" look
Mallard (puddle duck)	long wide, flat, sieve-like beak is used for pulling up aquatic plants as it "dabbles" upside-down in shallow water	legs set near middle of body, and with normal-size back toe; adapted for swimming in shallow water wetlands	puddle ducks favor shallow ponds and marshes, unlike diving ducks they leap up out of the water to fly
Canvasback (diving duck)	beak similarly long, flat and duck-like (as Mallard); adapted for feeding on deeeper-water vegetation	legs set further back on body (for kicking power in diving) with back toe enlarged to act as a rudder in swimming	diving ducks favor deeper waters; they skitter across the water surface before taking off in flight

After the Activity

Have the twelve birds assembled and in front of the class. Hold up each bird in turn and call on students to identify it and describe its adaptations for living in wetland areas. As you do this, you can also bring in other information (using the chart on the previous page) on the birds featured.

This is a good place to reemphasize the diversity of life forms that wetland areas support, and what great places they are to observe some of these bird (and other wildlife) adaptations in action. Although this activity focusses on structural adaptations, you may wish to point out that many birds have evolved neat behavioral adaptations as well (such as the heron using leaf and stick "lures" in fishing, or gulls dropping shellfish from the air to break the shells). Students should be reminded also that such structural adaptations have evolved in species over thousands of generations, and can not be readily adjusted to changes in the environment, such as filling in or draining of wetlands for development purposes. *This is another reason why preserving wetlands in their natural state is so important!*

A birdwatching trip to a wetland area near your school would make for an excellent follow-up. Check out the Field Trip list in the Appendix for information on opportunities available in your area.

Activity Adaptations

If not encouraged otherwise, most students tend to build the birds independently (each student in the group working on their own bird) and often by trial and error (rather than by following the clues presented). To adjust the focus, so that students work as a group and pay more attention to the clues, change the instructions as follows:

- Spread the 12 clue cards out, clue side up, on the table in front of the bird box. Each student in turn picks a card for the bird he/she is to build.
- Students then take turns picking a part for use in building his/her bird. This continues for three rounds, until each player has built his/her bird.
- At this point, players check the codes on the back of the cards with the parts they assembled. Each correct part earns 5 points. Mismatched parts should be corrected before continuing. Keep playing until all 12 birds are constructed.

Activity Extensions

Fill the Bill (pages 29-30 in *Wading into Wetlands*) offers a wonderful way of making these feeding adaptations more concrete for your students. This involves setting up eight stations (each with a special type of food and three different types of tools) challenging students to find the tool that works best for each food.

Fashion a Fish (pages 88-91 in Aquatic WILD) is an activity that engages students in creating an imaginary fish species designed with adaptations to meet certain environmental situations. This could be used as is or adapted to involve students in creating a wetland bird adapted to some specialized feeding or habitat conditions.

Wetland Wierdos (pages 94-98 in the *WOW!* book) extends the learning about wetland adaptations to plants (through a cattail stem and leaf dissection) and mammals (via a story about beaver adaptations).

Beyond Build-a-Bird Take advantage of the interest generated in *Build-a-Bird* to get students to learn more about these fascinating creatures. Assign each individual/team of students a different wetland bird to research (there are many more besides the 12 used here, see *Water Birds* book). The report to be produced could include information on where and when the bird migrates, its nesting activities, food preferences, songs/calls, behaviors, and other interesting features. For language arts, challenge students to create rhymes or riddles that describe the feeding adaptations of each bird.

Assessment

A worksheet-style assessment tool, featuring the matching of beaks or legs with foods or habitats, is offered in the Appendix section of this notebook.

Other Resources

Puddler magazine (several issues of which are included in the supplementary tub of the Kit) features several interesting articles on waterfowl and other wetland birds. The Spring 1996 issue focusses on the flight adaptations of birds.

Water Birds (also included with supplementary tub) provides a useful source for further information and activities for interested students to follow-up on what they learned doing *Build-a-Bird.*

Quack, Quack, Human Impact

Overview

This activity uses a "dilemma card" approach to explore issues relating to human use of wetlands. Each player is presented with a wetlands/land use situation and must select one of three choices for how he or she would act relative to that situation. Each action results in two kinds of consequences, one for wildlife and the other for humans and the economy. Movable bead sets (brown for ducks and green for dollars) are used to keep "score" of the consequences of each player's wetland "decisions".

Objectives

After successful completion of this activity, students:

- will realize that wetlands can be used to meet a variety of human land use needs
- will recognize that decisions about human uses of wetlands result in consequences to wildlife, humans and the economy.
- will understand that each situation presents various options, each resulting in different consequences, and none necessarily being "right", "wrong", or agreeable to all parties.
- will appreciate the value of considering all sides of an issue before making a decision.

Vocabulary*

developer	man-made wetland	mitigation
dredging	natural wetland	restoration

* most of these words do not appear during the "doing" of the activity, but may be introduced in follow-up discussions.

Skills

decision-making, reading and evaluating information, issues exploration, recognition of multiple points of view, and weighing the consequences of actions

Background

Much has already been written regarding the sorry history of human impact on wetland environments. The oft-quoted fact that we (both as nation and state) have destroyed over half of our natural wetlands since colonial times speaks essentially to that issue. In recent decades, thanks to growing awareness and appreciation of the benefits of wetlands, the tide appears to be changing, resulting in much greater emphasis on conserving what remains of our wetland resources. This emphasis has taken several forms, including: 1) stronger legislation (specifically Section 404 of The Clean Water Act federally, and The Coastal Zone Management Act in Delaware), 2) the emergence of preservation-through-purchase programs (as practiced by the *Nature Conservancy* nationally, and various organizations statewide), and 3) an increased effort by natural resource agencies to carry out restoration projects in wetlands that have been degraded by past human activities.

Although these and other programs have helped slow the rate of loss substantially, it is important to realize that wetland destruction is still a reality in this country to the tune of about 300,000 acres a year. That translates to three acres lost every five minutes! Globally, the equivalent of 17 football fields worth of wetlands are lost every minute! In other words, the pressures to develop or otherwise "convert" wetlands for a variety of human uses are still "out there", and the issues surrounding this are many and by no means simple and clear-cut.

In the past, filling and draining were the major causes of wetland loss, mainly for use as farmland in rural areas, and for urban development in and around most of our coastal cities. Although today's laws offer pretty solid protection against both of these "conversions", current threats persist in the area of residential development (i.e. increased demand for housing, shopping plazas, roads, etc.). For at least for some of these uses, laws requiring "mitigation" (creation of man-made wetlands of comparable acreages and types to replace those lost through development projects) are also common.

Before the Activity

Ask students to think about things they have done that help the environment. List them on the board. Then make a second list, asking for examples of things your students do or have done that might be harmful to the environment. Encourage thinking that goes beyond the obvious activities, such as littering. If your class has trouble with this, get them to think about the stuff they use and buy as consumers (electricity is a good example) and what environmental "costs" might have been incurred from its production.

Ask students to think about how this might relate to wetlands. Point out that most of our large coastal cities (Boston, New York, Philadelphia, Washington, etc.) were built on wetlands. The same for some shopping plazas, sports fields, amusement parks (including Disney World) and other places we enjoy.

Add to this millions of acres of wetlands that were turned into farmland earlier in this century. Put another way, wetlands have been filled and drained for all kinds of reasons, and we have and do indirectly benefit from those "losses" in many ways. At the same time, we all pay for the increased flooding, poor water quality, loss of wildlife habitat and other problems that accompany wetland loss.

Point out that many of the important decisions we make in our lives have pros, cons and trade-offs. The key is to think before doing - about the options pvailable and what their consequences might be - and then make a decision that makes the most sense for the situation. With this background in mind, review the opening paragraph of the *Quack, Quack* instructions (reprinted below) with your class, asking them to summarize/paraphrase important points, before moving on to doing the activity.

How to Play Quack, Quack, Human Impact

This game is based on real-life decisions that people make and the impacts those decisions have on the wetlands and wildlife around us. Each yellow card presents you with a wetlands use situation and three options for what you would do if put in that situation. In this game, ducks (brown beads) are used to show the impact your decisions have on wildlife and dollars (green beads) the human/economic consequences. Please realize that there are no clear "right" or "wrong" answers to these situations. A choice that might be good for ducks, could be bad for the economy. What's good for the economy, could be bad for ducks. Some decisions are bad for both, and a few can even be good for both. The idea is to try and put yourself in each situation and be as honest as you can about what you would do. Keep this in mind as you play.

- ☞ Each player draws a blue *Duck Card* from the pocket provided. This tells you your team name and which bead rows to play. Top row team plays first, next-to-top second, etc.
- ☞ Each player has two rows of beads (a green row for dollars, and a brown row for ducks) and starts the game with a population of 10 ducks and a bank balance of 10 dollars. Indicate this by moving 10 beads of each color to the left side of the game board.
- ☞ A yellow *Decisions Card* is chosen and read (aloud) to the player whose turn it is by the player to his or her left.
- ☞ The player makes his or her decision. The person who read the question then turns the card over to read (aloud) the consequences of that decision. Ducks and dollars are added or subtracted by moving that player's beads accordingly.
- ☞ This process is repeated as each player takes turns until all cards are gone or each player has had at least two turns.

When done, please return all cards/beads to their starting places for the next group!

After the Activity

With the *Quack, Quack* board in view, survey your students to find out how they did with this activity. *How many ended up with more ducks than dollars? Who scored more on the dollars than for the ducks? How many felt like they had a good balance of both? Did you find any of these decisions difficult to make? Which ones? Why? Do you think the choices you made reflected what you would really do if such situations were to actually occur in your life?*

Revisit the discussion on trade-offs initiated during the pre-activity discussion. Ask students what, if anything, they would be willing to do or give up in to help preserve wetlands and other natural resources for future generations. What will happen if we don't?

Review the green (*"So, who won the game?"*) sign on the exhibit to emphasize some of the issues and choices presented. If time permits, use the chart below to revisit some of the situations, and relate them to some current real-life wetland issues.

Decision Card Number & Description	Issues to Discuss
1) badly needed highway; choice between putting highway over freshwater marsh versus in area where homes/businesses displaced; 5) developer wants to turn a big chunk of waterbird/wetland habitat into a new water park/amusement park;	Both projects provide strong economic benefits, but at the expense of wetland habitat; both also allow for "mitigation" (constructing man-made wetlands to replace those lost). The latter is generally done at a 2:1 ratio (2 acres replaced for each lost) reflecting the fact that we can't "create" a fully-functioning wetland equivalent to what existed in nature. See Chapter 3 of "Saving Wetlands" for more on this topic.
3) popular shopping mall plans to make use of undeveloped field; could be developed as an extra parking lot, a park/picnic area, or a stormwater retention wetland.	This scenario is interesting because it offers the option of creating a wetland where one did not exist, in this case (as in Dover Mall) to serve a stormwater management function. More and more development projects are taking this route. In some areas (including Delaware), such acreages can be "banked" for future mitigation in other development projects.
2) school in need of more playground area; wetlands would have to be removed; 6) homeowner with skeeter-infested swamp; neighbor suggests digging out to make pond	Both situations have to do with relatively small wetland areas that would be altered to serve human recreation interests, with little or no economic gain. Both also offer the option of leaving things as they are, while looking for other ways to address the concerns that prompted the development plans.
4) new military base to be located on wetland, would provide much-needed jobs for town; 11) small, bayside town wants to expand marina over salt marsh to meet tourist needs	These projects are similar in that they both would provide economic benefits to a small town, offering more jobs and income as a trade-off for a certain amount of wetland loss. Both also offer reasonable compromise options for people on opposite sides of the issue to meet halfway.
8) ready-to-retire farmer to sell part of land - to developer, conservation group or farmer? 9) farmer facing hard times to decide if should return now unplowed "wet" area to cropland;	These situations represent farmland vs. wetland issues. Although in the past, a large percentage of wetland loss was from farmland conversion, laws today prohibit such activity, and in some cases, offer tax breaks and other incentives for farmers willing to return part of their land to wetlands.
7) kind-hearted person deciding whether to donate to conservation group or scout project 10) student deciding if and what wetland project he or she is willing to volunteer for	Both situations have to do with people deciding whether to give of themself (time or money) for a wetland cause, or hold back because of uncertainty about their own personal needs. One also presents the dilemma of global vs. local causes. These are choices that depend on individual value systems.
12) young hunter encouraged by best friend's father to shoot at ducks out-of-season;	Presents the issue of holding true to what you know is right (regardless of who tells you otherwise); also a good place to talk about why we have wildlife/wetland regulations.

Activity Adaptations

Although *Quack, Quack* is designed to be used as a learning center exhibit/activity, you may find that you get more educational value from it by presenting it as a whole class, teacher-facilitated activity. To do so, remove the decision card set from the exhibit, and pass out a different card to each pair of students. Ask them to read the card carefully, decide what option they prefer (ignoring the consequences on the back), and prepare to explain their choice to the class. Also, if they are so inclined, encourage them to make up their own option to fit the situation. Then go around the group, allowing each pair to present their situation and choice, and others to offer comments accordingly.

Activity Extensions

The supplementary resources part of the wetland kit provides a wealth of excellent activities dealing with wetland/human impact issues education, including:

Hydopoly (pp. 260-265 in the *WOW!* book) is a decisions cards-based board game that would serve well as either pre- or post- to *Quack,Quack.*

Dragonfly Pond (pp. 154-158 *Aquatic WILD!*) involves students in planning a wetland development project relative to different interest groups.

Here Ye! Hear Ye! (pp. 253-259 in *WOW!*) provides twelve roles designed to engage students in conducting a mock public hearing on a proposed wetland development project.

Old Tillage Farm (flip side of *Wading into Wetlands* poster in resources tub) offers a wetland development simulation designed to get students exploring the pros and cons of these issues.

A Wetlands Public Hearing (pp. 116-123, from *A World in Our Backyard*) offers another variation on the wetland development hearing theme.

Wetlands: How to Make a Difference is a video from the National Audubon Society that deals with issues like those raised in *Quack, Quack.*

Regulation Rummy (pp. 270-277 in WOW!) presents a unique venue for increasing student awareness of the multitude and complexity of regulations governing human activity in wetlands.

pp. 55-90 of *A Study Guide to New England's Freshwater Wetlands* includes five current event articles (one from Delaware) dealing with issues relating to wetlands creation and restoration projects (includes study questions for each case).

Wetland Politics (Activity 2 in the USF&W's *Wetlands Conservation and Use* issues packet) engages the class in participating in a mock election, in which students select a candidate based on their views on wetlands and their uses.

The Delaware *Adopt-a-Wetland* Program offers school groups and other parties the opportunity to get involved in hands-on, local wetland stewardship activities. For more information, call the Aquatic Education Center at 653-2883.

Assessment

Challenge students to create their own decision and consequence cards, relating to wetlands or some other environmental area (non-point source pollution, the garbage crisis, fisheries depletion, acid rain, etc.) of your or their choice. Encourage them to explore and present the impacts (pro and con) relative to different interest groups and opposing points of view. A worksheet that incorporates in part this assessment approached is offered in the Appendix.

Informational Resources

Saving Wetlands: A Citizen's Guide for Action in the Mid-Atlantic Region (National Audubon Society) contains up-to-date information on wetland loss trin this area, federal/state regulations and agencies involved in wetlands management/protection, and ideas for what you as a citizen can do to help.

The Wetlands Issue: What Should We Do With Our Bogs, Swamps and Marshes is a NAAEE-developed Environmental Issues Forum packet that can greatly extend your group's exploration of wetland use issues. In addition to providing a balanced, in-depth look at this topic, this resource tells you how to set up a classroom study forum for debating the issues.

Chapters 5 and 6 in *WOW!: The Wonders of Wetlands*. (Environmental Concern Inc.) supplies a good overview of wetland/human impact issues, past and present.

Marsh Metaphors
Follow-Up Exercise

Name Answer Key

Date _____

Make up a *Marsh Metaphors*-type clue that would make sense for each of the objects pictured below. Write each clue in the box below each picture.

Wetlands provide nursery habitat for the young of many animals; wetlands serve as great places for rest and relaxation; wetlands offer shelter/protection from rain, wind and storms.	*Wetland resources (timber, fish, etc.) can be harvested for money; wetlands save $ by reducing flood damage & improving water quality; wetlands are often developed for human use and profit.*	*Wetlands can lock-up pollutants that would otherwise get into adjoining rivers, lakes & bays; wetlands play a key role in natural systems and processes; wetlands should be protected!*
Answers will vary!	*Answers will vary!*	*Answers will vary!*

For each of the wetland benefits below, come up with an object that you think would make a good metaphor for it (but one that is different from any of the objects above or that you used in class). Write or draw the object in the box above each clue, and explain why you think that object fits it.

Rain gear/Boots *Umbrella* *Wet suit of SCUBA diver*	*RV/Camper* *Spa/Resort Hotel* *Fast Food restaurant*	*Binoculars* *Books* *School*
Answers will vary!	*Answers will vary!*	*Answers will vary!*
Wetlands help reduce storm damage in coastal areas by acting as a "buffer zone" between ocean and dry land.	Wetlands provide critical resting and feeding habitat for many of our migratory waterfowl and shorebirds in the United States.	Wetlands provide places for people to observe and learn more about plants, wildlife and the natural world.

Use the back of this paper to write a letter to a politician, planner, or some other person aimed at trying to convince them of the importance of valuing and protecting our wetland resources.

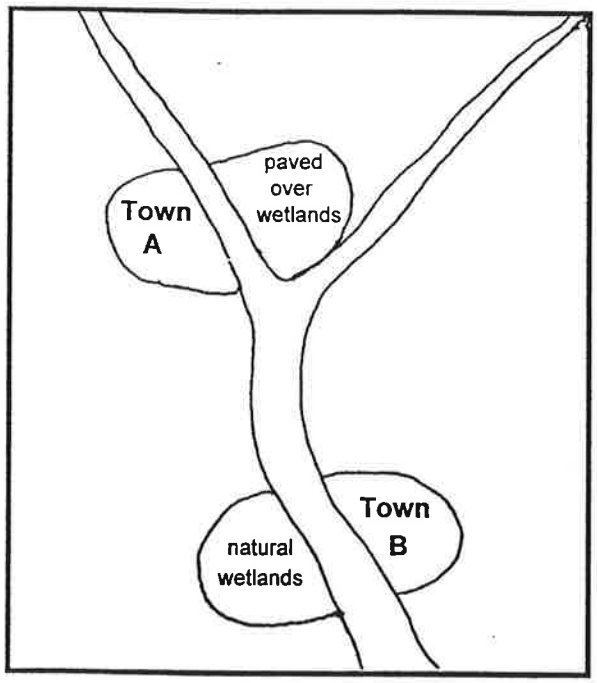
Marsh Model

Follow-Up Exercize*

Name Answer Key

Date _____

The map below shows two riverside towns. Most of the wetlands around Town A have been filled in or paved over for development. Town B has managed to maintain most of its surrounding wetlands in their natural state. Town B is located downstream from Town A. During a period of bad flooding, which town do you think will experience the most damage? Give reasons for your answer.



Even though Town B is doing the right thing by preserving its riverside wetland areas, it is likely to receive more damaging flood impacts. This is because the paved-over wetlands near Town A are no longer available to absorb flood water, resulting in greater volumes of water being released downstream where Town B sits.

Some students might argue that if there are more paved-over or filled wetlands upstream from Town A, they could experience as bad or worse flooding as Town B, but since that information is not provided, we can't be sure.

Town B's conservation practices will likely prove beneficial in reducing flooding for towns further downstream. This is a good place to introduce the aphorism: "We all live downstream".

Circle the answer that is not correct:

A) Wetlands can help reduce the damage done from floods and storms
B) Wetlands make the water coming out of them cleaner and clearer looking.
C) Wetlands can help keep well water supplies replenished in times of drought.
(D) Wetlands pollute underground water supplies by releasing pollutants into them.

Unless overwhelmed with pollution loads to the point that they can't function, wetlands can help remove nutrients and other pollutants from the water passing through them.

Describe how the marshes located along the Delaware River and Estuary could help protect people living just inland from the Bay from the devestating effects of a severe hurricane.

Severe hurricanes bring high waters, heavy rains and strong winds. In areas where wetlands separate homes and businesses from the coastline, some of these high waters can be absorbed, and strong winds diminished, as they pass over and through the adjoining wetlands. When wetlands are filled in or paved over, these capacities are lost, and inland areas are hit with the full force of the storm impacts, resulting in much greater damage to people and property.

* These questions were adapted from the *Freshwater Marsh Habitat Pac*, © 1980, U.S. Fish and Wildlife Service

Name that Wetland!

Follow-Up Exercise

Name Answer Key

Date _____

Write the letter code for the name of the wetland type in the blank next to the clue that best fits it.

CD = Cedar Swamps	**B** = Bogs	**CP** = Coastal Plain Ponds
CY = Cypress Swamps	**FM** = Freshwater Marshes	**IW** = Interdunal Wetlands
HS = Hardwood Swamps	**SM** = Salt Marshes	**SS** = Scrub-Shrub Wetlands

_SM_ 1. These grass-dominated wetlands are the most abundant habitat type bordering the Delaware Estuary and Atlantic Coast.

_HS_ 2. Blackened masses of fallen deciduous leaves on the forest floor help identify this type, which is the most common and abundant wetland type in the state.

_CD_ 3. A mixture of tall evergreens and smaller deciduous trees and shrubs occur in this relatively rare, but ecologically important wetland type.

_CP_ 4. Small in size, but many in number, these pools of water in the woodlands dry up in summer and fall, but provide important habitat to amphibians in spring.

_IW_ 5. You might find these small depressional wetlands behind the dunes along selected Atlantic coastal beaches.

Your teacher is going to show you five pictures, each picturing one of the wetland types you learned about from the list above. Next to the number that goes with each picture, write the name of the wetland type you think it is, and your reasons for thinking so.

1. ***Freshwater Marsh**: the absence of trees and shrubs means that this is not a swamp. The variety of vegetation, especially broad-leaved type, identifies it as freshwater marsh.*

2. ***Coastal Plain Pond**: the small, pond-like depression that holds water temporarily, and the fact that it is surrounded by woodlands, are key elements in this identification.*

3. ***Scrub-Shrub Wetland**: the predominance of shrubby vegetation, along with the river/ stream-side location, identifies this wetland habitat as a scrub-shrub type.*

4. ***Hardwood Swamp**: the predominance of trees identifies it as a swamp-type wetland. The deciduous (broad-leaved) nature of the trees identifies this as a hardwood swamp.*

5. ***Salt Marsh**: the absence of trees and shrubs means that this is not a swamp. The prevalence of grasses (giving it that "sea of grasses" look) identifies it as salt marsh.*

Wetland IQ
Follow-Up

Name Answer Key DE

Date _____

Test your Wetland Wisdom by circling your choices for the best answer to each of the 10 questions.

1. About what portion of Delaware's land area today consists of wetlands?
   18% of Delaware's land area today is wetlands.
   A) one-tenth B) one-fifth C) one-third D) one-half

2. *True or False?* Wetlands are defined as areas of land with water visible at the surface throughout the year. *The "throughout the year" part makes it false. Some wetlands may appear dry at the surface for spans of several years.*

3. Which of the following is <u>not</u> a characteristic that defines a wetland?
   Though many wetlands are located near water bodies; there are kinds (e.g. Delmarva Bays) that are not.
   A) soils that tend to hold water and drain slowly
   B) always located along a stream, river, bay or other water body
   C) soils that tend to be waterlogged in the root zone for much of the time
   D) the prevalence of plants that are adapted to living in waterlogged soil conditions.

4. The most abundant type of wetlands (by total acres covered) in Delaware today are:
   A) coastal tidal marshes *(2nd most abundant)* B) coastal plain ponds *(many in #, small in area)*
   C) forested wetlands *(58% of DE's wetlands)* D) Bald Cypress swamps *(only in Sussex)*

5. *True or False?* Conversion to farmland is the biggest cause of wetland loss today.
   The "today" makes it false. In the past, this was so, but today residential development causes the most loss.

6. Which of the following statements comes closest to describing wetland loss in our nation?
   Over 500,00 acres of wetlands are still lost in the U.S. every year.
   A) We have lost a lot of wetlands, but thanks to tough new laws, are no longer losing them.
   B) We have lost over half our wetlands, and are still losing thousands of acres every year.
   C) We have lost nearly all of our wetlands, but what remains is fairly well-protected.
   D) We never really had many wetlands, so losses today are hardly worth worrying about.

7. Swamps are distinguished from marshes mainly by:
   Swamps are wetlands in which trees predominate; in marshes non-woody plants are dominant.
   A) the amount of water found there B) the presence or absence of tidal flow
   C) their capacity for absorbing flood waters D) the kinds of plants growing there

8. *True or False?* Because of the water they hold, wetland soils tend to have lots of oxygen.
   No again! Soils that are waterlogged have little or no space available for air.

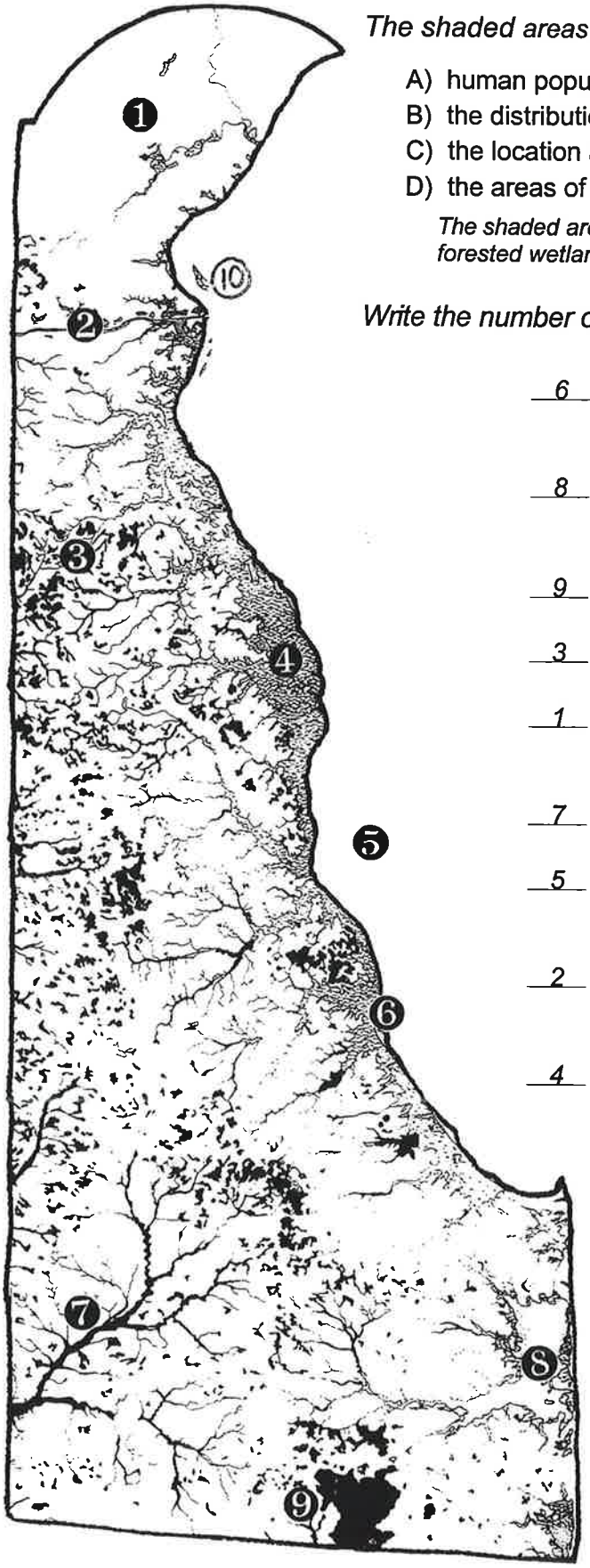
9. Which of the following statements about wetlands is <u>untrue</u>?
   Actually, wetland plants help clean up some forms of pollution by absorbing nutrients and trapping sediments.
   A) They include some of the most productive ecosystems on the planet
   B) They help replenish groundwater supplies by holding on to water in times of drought.
   C) They can pollute nearby waters by releasing foul-smelling substances into the water.
   D) They provide homes to many rare, threatened and endangered plants and animals.

10. Which of these wetland types are we losing most rapidly in Delaware today? *B & D rare in DE.*
    Because they tend to be less wet, and are less protected, hardwood swamps are prone to development pressures.
    A) hardwood swamps B) bogs C) coastal marshes D) interdunal wetlands

WetQuest DE
Follow-Up

Name Answer Key

Date _____



The shaded areas on this map describe (circle the letter of the best choice):

A) human population levels of communities in the state of Delaware.
B) the distribution of endangered species on the Delmarva peninsula.
C) the location and types of wetland habitats found in Delaware.
D) the areas of land in Delaware that are protected from development.

The shaded areas represent wetland areas in Delaware. The black areas show forested wetlands (swamps). The other shaded areas are mostly marshes.

Write the number of the map site that you think best fits each clue below.

6 provides spawning habitat for the largest population of horseshoe crabs on the planet

8 osprey are often sighted fishing the large, salty, pond-like waters of the Inland Bays area of the state

9 location of Delaware's largest area of Cypress swamp

3 "whale wallow" wetlands are concentrated in this area

1 represents a part of Delaware that is characterized by a more hilly topography

7 this area of is part of the Chesapeake Bay watershed

5 weakfish, flounder and other estuarine fishes provide for popular recreational fishing in this area of Delaware Bay

2 provides a "shortcut" for ships travelling between the Delaware and Chesapeake Bays

4 the salt marshes in this area are managed to provide prime viewing areas for migratory water birds

Locate another area/site on the map and label it ⑩ Use the space below to write a paragraph that describes the habitat, animals and other neat stuff about that site.

Pea Patch Island is one of Delaware's special spots! In addition to being the site of a Civil War Fort/prison, this small island on the Delaware River is the place where thousands of pairs of nesting herons, egrets and ibises come each spring to mate, nest and brood their young.

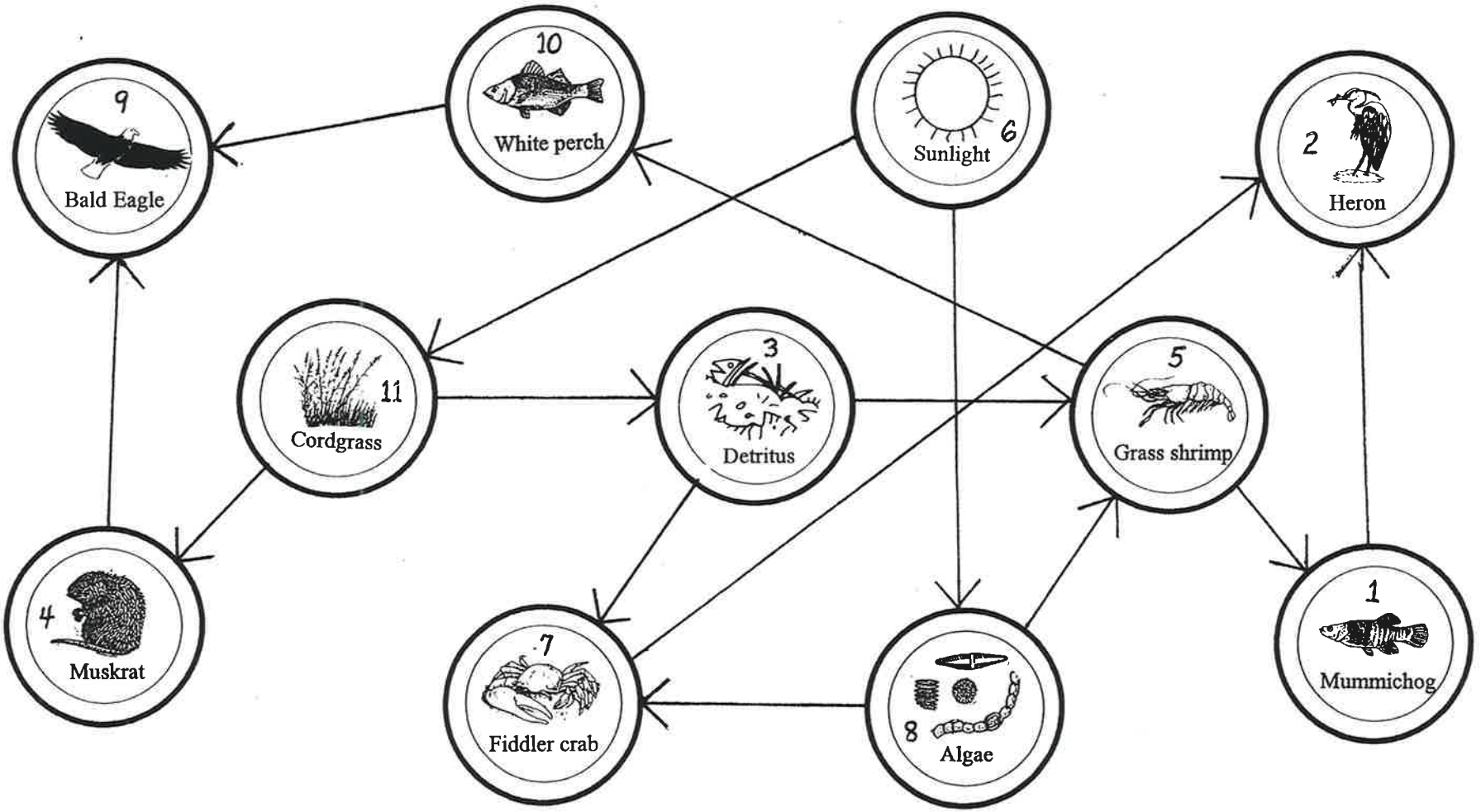
Wetland Cafeteria

Follow-Up Exercize

Name Answer Key

Date _____

Salt Marsh Detectives: The circles in the drawing below represent pieces of a salt marsh food web. This is a two-fold challenge. First, using the page attached, write the number of each of the clues inside the drawing of the object or critter you think it matches. Then cut out each of the circled pieces and paste each into the place on the food web drawing below that you think it belongs. Please note that the direction of the arrow on the food web drawing shows the direction in which energy moves in the marsh system. For example if an arrow is drawn from object 1 and points to object 4, this means that object 4 gets its energy from using object 1.



Build-a-Bird

Follow-Up Exercize

Name _____

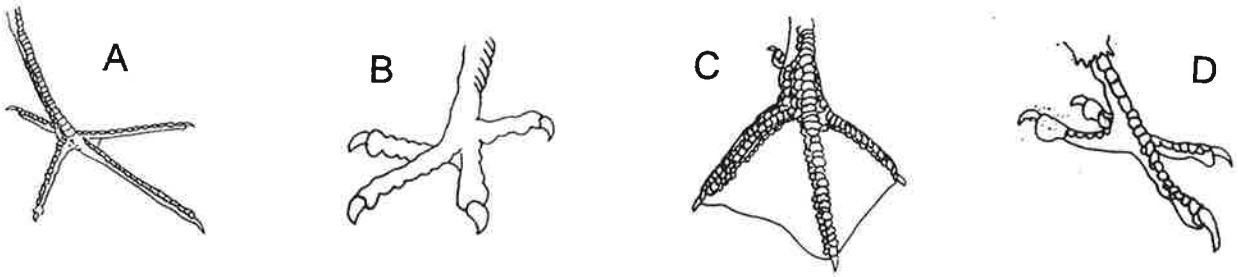
Date _____

Quite the feet! Each of the clues below describes a legs/feet adaptation belonging to certain wetland birds. Match each clue provided with the letter of the "feet" drawing that you think fits it. For bonus points, write the name or names of the kinds of birds that have those kind of legs/feet.

C 1. My wide, webbed feet are well-suited for swimming.

A 2. My toes are long and well-spread for wading and walking on the mudflats.

D 3. My toes are short, close and well-clawed for perching on branches and stalks.



You do the clue! Look at the bird bills pictured and think about what each can tell you about how and what the bird eats. In the box with the bill drawing, write the name of a bird or birds that you think has that type of bill. Then, in the "clue" box, make up a clue that describes the shape and other special features of that bill, including how you think the bill helps the bird in feeding.

Bird	Clue
Birds of Prey Hawks Owls Falcons	*My bill is short, strong, and powerful, featuring a sharply hooked, overhanging, upper beak adapted for tearing the flesh of prey species that I catch and kill.*
Shore-birds Sandpipers Rails	*My long, slender, pointed bill is well-adapted for probing and searching in the mudflats for worms, crustaceans and other small critters I consume.*
Wading Birds Herons Egrets	*My long, strong, pointed beak serves me well in spearing fish, crabs and other critters living in the wetlands where I do my feeding.*

Design a Bird Challenge Use the back of this page to design and draw your own imaginary bird. Be sure that the bill you give the bird is made to suit the special kind of food it eats. Be prepared to show your drawing to the class and describe how your imaginary bird is adapted to its environment.

Human Impact

Follow-Up Exercize

Name _____

Date _____

The people of Perch Point, a small, rural community bordering the Delaware Estuary, have just been informed that Cy Soybeans, a recently deceased landowner from the area, had bequeathed his 350-acre farm to the community "to do with as the majority of the town people see fit". This land includes a small pond, 50+ acres of swamplands, and several areas that were once wetlands, but had been drained long ago for farming. The town must decide whether to hold on to the land or sell it; and if they sell it, who they would sell it to. Profits from sale of the land to developers could be used to build a much needed school or to upgrade the inadequate sewage treatment facilities for the community. A decision not to develop would allow the town to preserve some of its rapidly disappearing open spaces for future wildlife habitat and human recreation. A town meeting is being convened and residents are encouraged to weigh the pros and cons of each of four options under consideration, and speak their mind about what they think the town should do with the land. Put yourself in the role of a resident and write down the pros and cons for each choice presented below, along with a concluding paragraph that tells which choice you would vote for and why. Feel free also to suggest an alternative option, and make a case for why you feel this would be the best choice for the community to make.

A) sale to a developer, who will subdivide all of the land that is currently in farmland and most of the swamps to create some much needed housing for the rapidly growing population of the area;

Pros: good for economy, human needs; money could be used for school or sewage treatment needs; more people living in town means more tax dollars for schools and other systems

Cons: open space lost and chance to reclaim wetland habitat for wildlife, recreation, etc.; more homes means more pressure on environment and systems in town.

B) sale to an entrepreneur, who plans to build a bayside resort to support the growing tourist trade; this would involve digging out the lower, wetter areas of the farmed fields and flooding them to create a large lake, and then surrounding the lake with hotel, restaurants, golf course, tennis courts, and other amenities to attract visitors to the area;

Pros: great for economy; would bring lots of outside money and jobs to town; money from sale could be used to meet towns school or sewage system needs.

Cons: open space lost and chance to reclaim wetland habitat for wildlife, recreation, etc.; more people means more pollution and other pressure on environment.

C) sale to the state (for about half of what the developers would pay) to manage the land as a fish and wildlife area, including some restoration of the once farmed areas to wetlands;

Pros: preserves open space, improved habitat for wildlife,and recreational opportunities for people; flood control, water recharge, water quality improvement, and other wetland values also offered.

Cons: less money from sale of property to meet needs of town for improved schools and sewage systems; few, if any, new jobs or other amenities provided; tax base for future revenues will also be lost.

I would vote for "C" because it would preserve our most rapidly disappearing resource in the area - open space and wetlands - for the future. There are other areas where housing developments could be located. As for the resort option, athough this would bring in lots of jobs, and money we could use to make the needed improvements in our school and sewage systems, the influx of people into the area would put even more pressure on these and other systems (e.g. transportation) in the long run. I look at this as a gift - something we didn't expect to have - we shouldn't be greedy, but should use it to give something back to the land and our children - a place that is kept green for all time, rather something we sell for some quick and easy "green" that will be gone in no time.

Materials Available in Supplementary Resources Component of the Kit

Videos

A World in Our Backyard: a Wetlands Education and Stewardship Program, 1993, New England Water Pollution Control Commission. Includes a 7-minute video introducing students to wetlands, a 15-minute video for teachers showing how to use wetlands as outdoor classrooms, and a 140-page guidebook full of background information and outdoor activities. A useful resource for teachers who wish to get their classes involved in adopting, stewarding and/or studying a wetland at or near their school.

Fabulous Wetlands, Washington State Department of Ecology. Features Bill Nye "the Science Guy" in a seven-minute exploration of what wetlands are, why they're important and other neat stuff. Recommended for use as an opening act, prior to use of the Wetland Kit activity stations

The Living Tidal Marsh, Public Service Electric & Gas of New Jersey. Includes a three-part video program and accompanying teacher's guide/activity book, focussing on the ecology of Mid-Atlantic tidal marshes. Much of the material ties in nicely with the salt marsh theme of the *Wetland Cafeteria* part of the kit.

Wading Into Wetlands, 1996, National Wildlife Federation. This two-part program, specially produced for grades 4-8 for Wildlife Week '96, includes a short orientation to wetlands, and a one-hour broadcast MC'd by Billy Bee, "the Science Song & Dance Man", featuring games, songs, demos, interviews (with experts and kids), and question & answer exchanges from schools across the nation.

Activity Books

A Study Guide to New England's Freshwater Wetlands. New Hampshire Department of Fish and Game. Offers several activities for the field and classroom, including a series of current event case studies that allow students to explore and debate issues relating to human uses of wetlands

NatureScope: Wading Into Wetlands, 1992, National Wildlife Federation. Features a variety of enrichment and extension activities on wetlands for all ages, ranging from arts & crafts to issues-related.

Wildlife Week '96 Wading Into Wetlands packet, 1996, National Wildlife Federation. Includes some reworked versions of the NatureScope materials and some new activities and info you may find useful. Don't overlook the role-playing activity offered on the back of the Wildlife Week poster.

WOW! The Wonders of Wetlands, 1995, Environmental Concern, Inc. and The Watercourse. 330 pages packed with information, activities for the classroom and field, and so much more. The resource of all resources for getting started and going far with wetlands education. We refer to this in just about every section of the Wetland Kit Guidebook as both a source of background information and enrichment activities.

Posters

Common Myths and Misconceptions About Wetlands and the Startling Truth, U.S. Environmental Protection Agency. Promotes awareness of just what the title says, including information not found elsewhere.

Wetlands: Water, Wildlife, Plants & People!, U.S. Fish & Wildlife Service. Large, colorful, cartoon-style poster illustrating various wetland types, plants and wildlife associated, and assorted human activities. Activities (on back of poster) are useful as extensions for *Marsh Model*, *Metaphors* and *Name That Wetland!*

Wetlands, We Need 'Em/Wetlands Are Important, U.S. Fish & Wildlife Service. This two-sided poster packs some good messages about the functions and values of wetlands. Relates well to the *Metaphors* activity.

Other Activity-Oriented Materials

Delaware Estuary Issues Packet, U.S. Fish and Wildlife Service. Set of nine card stock activity sheets about the Delaware Estuary and its wetlands. Although designed for the high school level, the material is well worth a middle school teacher's look, especially for the close-to-home content and focus.

Our Vital Wetlands, Lake County Water Authority, Florida. This colorful little booklet does an excellent job of presenting various wetland types, including several we have here in the Mid-Atlantic area. Could be put out as a resource for students using the *Name That Wetland!* activity station.

Puddler magazine, Ducks Unlimited. We are including several issues of this wonderfully-done wetlands magazine for kids in each copy of the kit. Provides good extra reading and project/report material for students who finish an assignment early and/or are looking to go further.

The Wetlands Issue: What Should We Do With Our Bogs, Swamps and Marshes, 1992, North American Association for Environmental Education. Provides background on wetland issues, instructional approaches, and other information relevant to setting up an issues forum relating to human activities in wetlands.

Water Birds, by Marj Dunmire, Pegasus Graphics, 1990. This information-filled, coloring book style, booklet provides excellent student enrichment for following-up on the *Build-a-Bird* learning.

Wetlands Conservation and Use Issue Pac, U.S. Fish and Wildlife Service. This is one of a series of habitat and issues pacs produced for educational purposes by the Service. We chose to include this one as a kit supplement because it offers some worthwhile activities for use in the area of human impact on wetlands.

Wetlands Plants and Animals, Dover Coloring Book Series, 1994. Though designed as a coloring book, the illustrations and information contained in this book could be used educationally at upper grade levels.

Wetlands Reading List: Pre-Kindergarten through grade 12, 1995, U.S. Environmental Protection Agency. Provides publishers information, summary and comments on available wetlands reading materials for kids. We hope in time to select an appropriate sample of what's reviewed here to include with the loan kit.

Wetland Tales: a Collection of Stories for Wetland Education, Washington State Department of Ecology This unique gem of a resource offers ten Native folk tales relating to wetlands. Each tale is followed by a page or two that ties what happened in the story to some aspect of wetlands ecology, use and values.

WINGO! (Wetlands of Delaware Bingo)

has participated in a beach, river or wetland clean-up day in the last three years	can give one of the three characteristics that define what a wetland is	can do an identifiable impersonation of some Delaware wetlands creature	can name one kind of Delaware Estuary fish that does its early growing in wetlands	can name two kinds of turtles that can be found in Delaware wetlands
can describe the basic difference between a swamp and a marsh	owns a T-shirt imprinted with some sort of wetland creature	can name three kinds of ducks that spend at least some of their time in Delaware wetlands	knows the name of the wetland (swamp) tree that Trap and Trussum Ponds are noted for	knows someone who lives within one mile of a wetland area
can describe two ways that wetland plants can be helpful	can name an animal that can create wetlands		can describe what *detritus* is and how it's important to wetland ecology	knows what force makes the tides ebb and flow on this planet
knows the name of the Delaware River island famous for its large wading bird rookery	can name a critter with one big claw that makes its home in Delaware salt marshes	has constructed or put up a nesting box for birds, bats, or other wetland creatures	can give three good reasons why wetlands are worth saving	knows what a *whale wallow* is and where in Delaware they can be found
can name three kinds of insects that inhabit Delaware wetlands	has watched birds at the Bombay Hook National Wildlife Refuge	can name one kind of food that comes from wetlands	can name one of Delaware's *endangered* or *threatened* species that lives in wetlands	can think of one action we can take to help care for and conserve our wetland resources

Circulate around your class or group in search of indivduals who can meet the specifications described in any of the boxes. When you find someone who does, have him or her sign in the appropriate box. When you get five boxes in a row covered (vertically, horizontally or diagonally), call out WINGO! You may use any one person's signature no more than once.

WINGO! (Wetlands Bingo Game Card)

Circulate around your class or group in search of indivduals who can say "yes" to any of the clues described in your WINGO! card boxes. When you find someone who can, have her or him sign his or her name in the appropriate box. When you get five boxes in a row covered (vertically, horizontally or diagonally), call out WINGO! You may use any one person's signature no more than once.

TIPS FOR TRANSPORT/SET-UP/CLEAN-UP OF WETLAND DISCOVERY KIT STATIONS

General Transport:

- **Warning!** Stacking the entire kit can make the cart top-heavy and prone to tipping on slopes. Do not try to carry the entire kit on the cart unless you are only going across smooth, flat floor. If in doubt, its probably safer to break the kit up into 2 loads.
- Always stack activity stations with handles facing the same direction, and door openings up.
- The *Build-A-Bird* box should be on top of the other boxes, with the bird bodies tub, *Marsh Model* and supplemental materials tub at the very top.
- The cart is designed to fold-up for ease of packing. To do so, simply step down on the horizontal metal rod at the base of the handle, and lower the handle so that it folds down flat.

General set-up

- Do not open station boxes while they are laying flat. To ensure that stations are in an upright position to open, make sure that the station name is on the top side.
- Swing doors 2/3 of the way open - if you open doors all the way, they become very tipsy. When doors are at an angle, they help support the station and prevent it from tipping over.
- Unhook the velcro strips that hold the clue cards in the pockets, take the rubberbands off the card sets, and set the rubberbands aside (away from students) for repacking.
- Check parts inventory lists before and after use. Make note of any missing or damaged parts.
- When packing up stations, make sure all pieces have been placed in their pockets/containers, rubberbands around cards, velcro straps hooked over cards, and pencils secured in pockets (push pencil points into sponge in bottom of pockets as they were when you received the kit).
- **Please remember to fill out the evaluation form** (provided with the supplementary tub), including the grade level and number of students having used the kit.

Marsh Model

- Locate the Model station near a water source (sink) in your classroom. If there is no convenient water source, use a bucket, dish pan, milk jug, etc. for a water supply.
- Use of another container to dump dirty water will help keep things cleaner. In any case, have paper towels nearby, and don't put the model on or near anything you don't want to get wet.
- Pre-moisten sponges (wetlands) before doing the activity. Ring out the sponge so it is just damp (if a dry sponge is used, the water tends to flow under it, reducing absorption capabilities).
- Step #5 Tip: instead of removing the plug to drain the water body, leave the stopper in and tip the entire model over to drain the water into the measuring cup.
- Graduated cylinders are in 5 ml graduations. Students may need help figuring this out.
- When finished with the model, empty all containers of water and gently rinse out the model. Wipe residual water out of the model with paper towels. Rinse out sponges with clean water. Leave model and equipment out to air dry. **Do not close it up in its tub while wet/damp.**

Marsh Metaphors

- Keep the answer key cards in a separate pocket from the clue cards and turned around so that the answers do not show.

Name That Wetland

- After opening, test the light bulb by placing the points of the black and red probes together; this should cause the bulb to light up. If it doesn't work, remove the four screws that hold the inside panel in place, gently pull out the panel, and replace the battery with the spare provided. If it still doesn't work, screw out the bulb from the panel front, and replace it with the spare.
- Use and read the score card provided - it includes some important additional directions (this enourages students not to make wild guesses, if they are wrong they will lose points).

Wetland IQ

- After opening doors, make sure all answer cards are flipped so that a/b/c choices are showing.
- Humidity and temperature conditions sometimes cause the velcro closures on the answer cards come apart; check for this ahead of use, and press the velcro back together as needed.

WetQuest

- Check push pins to make sure they are all in place. Encourage students to be gentle when hanging clue cards on the "place" pins; the pin heads may break off if too much force is used.

Wetland Cafeteria

- Do not open the display doors if *Cafeteria* is not in the upright position. When upright, open the doors slowly - during transport chains may come loose and become caught on hooks.
- Flip the vinyl chain cover over the back of door, unhook the rubberband restraints and allow them to hang on the left side. These rubberbands are not to be taken off.
- In clean-up, make sure to arrange each chain color group evenly between designated hooks. Hang chains so that their color code tags are all on the same end, for ease of identification. Hang blue chains and white chains so that the ends do not hang below the edge of the door. Make sure all chains are tucked fully inside the rubber band restraints.

Build-a-Bird

- Transport the bird bodies in the separate tub provided; do not try to fit them in with the legs. Use the thick foam piece provided to serve as a protective layer between the bodies.
- When packing up the legs/head box, insert the thin foam piece in the inside of the lid (when using the box, be sure to store foam pieces in an area where they will be safe from damage).
- **Caution your students to be extra careful in working with the bird legs; we have filed them down as much as possible, but some of the edges are sharp and can cause injury.**
- **Be gentle with fitting the legs to the bodies.** Only certain combinations fit together easily. If incorrect combinations are forced, legs can be broken. In other words, if it doesn't fit right, don't force it - chances are its the wrong combination. Some of the bird beaks are sharp and somewhat fragile also. **Remind students to handle all these parts with care!**

Overview of Delaware Curriculum Standards & Performance Indicators for the *Wetland Activities for Delaware Educators* (*WADE*) Learning Kit

Subject Area	Grade 4-5 Standards	Grade 4-5 Performance Indicators	Grade 6-8 Standards	Grade 6-8 Performance Indicators
Science	1A, 1B, 1C, 2E, 5A, 5B, 6A, 6B, 6C, 6E, 6G, 7B, 7C, 8A, 8B, 8D, 8E	4.307, 4.309-4.313, 4.315-4.317, 4.319, 4.321, 4.323, 5.305, 5.310, 5.311-5.318, 5.320	1A, 1B, 1C, 2C, 3A, 3B, 3C, 4B, 5A, 5B, 6C, 6G, 7B, 7C, 8B, 8C, 8D, 8E	6.301-6.308, 6.319, 6.336, 7.310, 7.313, 7.332, 7.333, 7.335, 7.336, 7.339, 7.343, 7.345, 7.347, 7.349-7.356, 8.301, 8.305, 8.314, 8.327, 8.337- 8.341, 8.344, 8.345, 8.347, 8.348, 8.350-8.357,
Math	1.04, 1.05 2.01, 2.02, 2.03, 2.06 3.01, 3.02, 3.03, 3.04 5.40, 5.44, 5.60 6.40, 6.44, 8.62 9.40, 9.41, 9.43, 9.44 9.60, 9.62, 10.60	4.201-4.204, 4.207, 4.217, 4.218, 4.228, 4.232-4.237, 4.239, 5.201-5.204, 5.207, 5.215, 5.225, 5.228, 5.231-5.236, 5.238	1.04, 1.05, 2.01-2.03, 2.06, 3.01-3.04, 4.02, 5.40, 5.46, 5.60, 5.62, 6.40, 6.60, 9.40, 9.41, 9.44, 9.60, 9.62	6.201-6.204, 6.212-6.214, 6.217, 6.230, 6.232, 6.233, 7.201-7.204, 7.211, 7.212, 7.228, 7.230, 7.231, 8.201-8.204, 8.210, 8.211, 8.226, 8.229, 8.230
Language Arts	1A writing 1B oral 2, 3, 4	4.111, 4.118-4.145, 4.148-4.151, 4.153, 4.154, 4.156, 4.159, 4.161-4.171, 4.174-4.176, 4.179, 4.180, 4.187, 4.1100, 4.1105, 5.112, 5.118-5.120, 5.122, 5.123, 5.126, 5.130-5.143, 5.145-5.147, 5.150-5.153, 5.155, 5.157, 5.159, 5.160, 5.162-5.173, 5.175-5.179, 5.184, 5.190, 5.1103, 5.1108	1A written 1B oral 2, 3,	678.109, 678.112, 678.114, 678.120, 678.122-678.127, 678.129, 678.131-678.133, 678.135-678.139, 678.142, 678.143, 678.158-678.165, 678.167, 678.169, 678.172, 678.174-678.181, 678.190, 678.191, 678.196, 678.198, 678.199, 678.1101, 678.1102, 678.1105, 678.1106
Social Studies	E1, G1, G2, G3	4.412, 4.417, 4.421-4.423 5.409, 5.415 5.418-5.420	C3, C4, E1, G1, G2, H4	6.410, 6.417, 6.418, 6.419, 6.423, 7.421, 7.422, 7.423, 7.426, 8.406, 8.408, 8.410, 8.413, 8.421, 8.422, 8.423, 8.424, 8.433, 8.432