Virginia Water Central

Virginia Water Resources Research Center Blacksburg, Virginia February 1999

FEATURE ARTICLE

The Flow of Federal Water Laws

With a stroke of the president's pen, ideas that have been introduced, developed, and passed by Congress become federal laws. From that point forward, the enacted legislation requires an implementation process involving the public, federal agencies, state and local agencies, and other groups. In many cases, the implementation requires development of federal regulations, or **rules**.

This article enters the story at the point where a federal agency begins the rulemaking process. We consider a single rule from the 1996 Amendments to the Safe Drinking Water Act (SDWA) to illustrate what happens at particular steps of the rulemaking process. The 1996 amendments included a section that requires each **community drinking-water system**[1] to provide its customers an annual report on water quality. The first of these **Consumer Confidence Reports** must be provided to water customers by October 19, 1999. The story we describe is summarized in the chart on page 2.

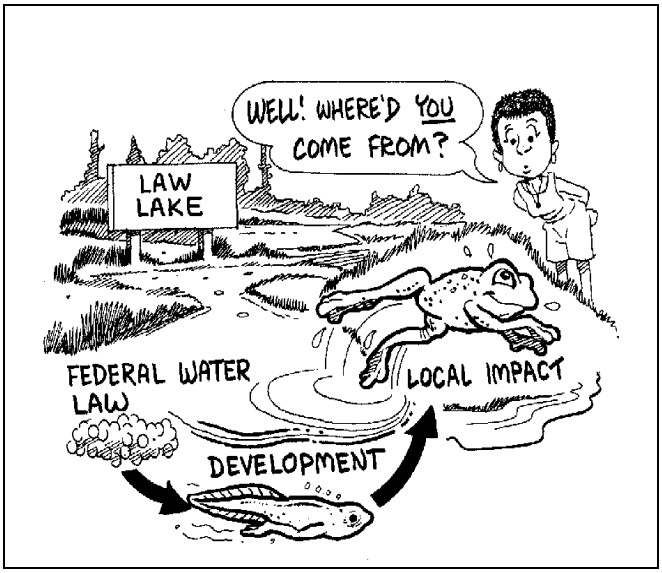
The rulemaking process varies among different Congressional acts, so there is no single path by which federal regulations are established. The Consumer Confidence Reports, however, offer a timely and relevant example of the development and implementation of a *relatively* simple rule.

Legislation is Just the Beginning

When a federal agency receives a new piece of legislation for implementation that requires issuance of regulations, the agency must follow procedures established by Congress. The procedures are contained in several laws: the Administrative Procedure Act, the Regulatory Flexibility Act (as amended by the Small Business Regulatory Enforcement Fairness Act), the Unfunded

Continued on page 3

INSIDE THIS ISSUE



[1] As defined by the U. S. EPA, a "community drinking-water system…serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents."

An Example of Federal Rulemaking:	The Case of the Consumer Confidence Reports
An idea debuts officially in Congress.	**Nov. 29,1995**—Senator Barbara Boxer introduces an amendment to the Safe Drinking Water Act to require Consumer Confidence Reports.
The idea (in some form) survives the legislative process.	**August 6, 1996**—President Clinton signs the Congressional legislation enacting the 1996 Safe Drinking Water Act amendments, including the Consumer Confidence Reports requirement.
A federal agency is assigned to develop the details for implementing the legislation.	The U. S. Environmental Protection Agency (EPA) is responsible for implementing the Safe Drinking Water Act, including any necessary regulations.
Depending on the particular legislation, the federal agency follows a multi-step process for developing, publicizing, revising, and finalizing regulations, or rules, to implement the legislation.	**February 1997 to June 1997**—EPA seeks input on Consumer Confidence Reports from public, private, state, and local individuals and groups. **February 13, 1998**—Consumer Confidence Reports proposed rule published in the *Federal Register*; the public has 30 days to send written comments. **March 1998**—Two public hearings on the rule. **March 1998 to August 1998**—EPA considers comments, debates issues, develops revised rule. **Aug. 19, 1998**—Final rule published.
State develops plans and procedures for implementing the rule.	**Early 1997 to late 1998**—Virginia Department of Health creates Consumer Information Team to help develop plans for implementing the rule. Health department works with representatives from water utilities and waterworks organizations to create state regulations, and develops a plan to offer assistance to water system operators.
The regulated group begins to respond to new requirements.	Water system operators learn about the Consumer Confidence Report rule and how it will affect their system. They may attend workshops offered by the state health department or private organizations, or otherwise work with state and local officials to meet deadlines and distribute reports.
The idea-become-law takes effect.	**Oct. 19, 1999**—the deadline by which water system customers should receive their first report. The law's intent is that people use the information to make more informed decisions about water-quality issues.

Continued from page 1

Mandates Reform Act, the Paperwork Reduction Act, the National Technology Transfer and Advancement Act, and the Congressional Review Act.[2]

The *general* path for regulatory action is as follows:

"First, an authorized agency…decides that a regulation may be needed. The agency researches it and, if necessary, proposes a regulation. The proposal is listed in the *Federal Register*[3] so that members of the public can consider it and send their comments to the agency. The agency considers all the comments, revises the regulation accordingly, and issues a final rule. At each stage in the process, the agency publishes a notice in the *Federal Register*. These notices include the original proposal, requests for public comment, notices about meetings where the proposal will be discussed (open to the public), and the text of the final regulation.

"Twice a year, each agency publishes a comprehensive report that describes all the regulations it is working on or has recently finished. These are published in the *Federal Register*, usually in April and October, as the *Unified Agenda of Federal and Regulatory and Deregulatory Actions*.

"Once a regulation is completed and has been printed in the *Federal Register* as a final rule, it is 'codified' by being published in the *Code of Federal Regulations* (CFR). The CFR is the official record of all regulations created by the federal government. It is divided into 50 volumes, called titles, each of which focuses on a particular area. Almost all environmental regulations appear in Title 40. The CFR is revised yearly…"[4]

EPA Gets the Drinking Water Assignment

The U. S. Environmental Protection Agency (EPA) is in charge of implementing the SDWA. In 1994, EPA began phasing in a plan to streamline and improve its process for developing regulations, typically referred to as rules. The result was a "tiering" system that categorizes policymaking by the specific requirements of different types of rules.[5] For example, some rules require scientific studies to be done during the process before a **final rule** (a completed regulation) can be proposed, while other rules require outside agencies to be involved in the rulemaking process because the final rule will impact those agencies.

For the Consumer Confidence Reports, the relevant portion of the *U. S. Code* states, in part, that "The [EPA]…shall issue regulations within 24 months after August 6, 1996, to require each community water system to mail to each customer of the system at least once annually a report on the level of contaminants in the drinking water…."[6] The law also states that the reports must have the following information:

- the source, content, and quality of the water;
- a plainly worded explanation of the health implications of contaminants present at levels that exceed legal limits;
- information on compliance with national primary drinking water regulations; and
- information on the levels of contaminants that are unregulated but are of potential concern.

[2] An Internet site with information on Federal statues is **www.law.cornell.edu/uscode/**.

[3] The *Federal Register* is a legal newspaper published every business day by the National Archives and Records Administration. It contains federal agency regulations, notices, and presidential executive orders and proclamations. The publication is available electronically at **www.access.gpo.gov/nara**; it is available in paper at many public libraries.

[4] The quoted information was taken from the "Laws and Regulations" section of the U. S. Environmental Protection Agency's Internet site, **www.epa.gov**.

[5] A full, 50-page explanation of the EPA's tiering system for rulemaking is available from Phil Schwartz at the EPA, (202) 360-5493.

[6] The federal requirements for the Consumer Confidence Reports are included in section 1414(c) of the Safe Drinking Water Act (42 U.S.C. 300g-(c).

As clear-cut as these requirements may appear, chiseling in the fine details required input from all types of public and private groups, organizations, and agencies. That input, including a record of debate on issues raised, is summarized in the final rule, a 50-page document published in the *Federal Register* on August 19, 1998. Here is a *sample* of the public input that went into development of the rule:

- In February 1997, EPA officials met with waterworks operators in California, where a similar water quality report had been in use since 1990. EPA officials also met with California water customers and members of the Association of California Water Agencies to get information about their experience.
- EPA met four times between February 1997 and July 1997 with a special working group of the National Drinking Water Advisory Council (NDWAC). By law, NDWAC is empowered to provide advice to EPA on regulatory issues. The working group was composed of members from public health organizations; local, state, and federal government agencies with responsibilities for supervising public drinking water providers; operators of large and small drinking water systems; consumer representatives; environmental organizations; and business and trade associations.
- In June 1997, EPA met with private, state, and federal experts in public health and in the communication of risk-related information, to ask them for a critique of preliminary ideas.
- EPA published the proposed rule in the *Federal Register* on February 13, 1998. The public had 30 days to send in written comments, and two public hearings were held in March.
- Following this and other input, and debate over the issues raised, EPA developed the final rule and published it in *Federal Register* on August 19, 1998.

EPA's final rule was quite detailed in comparison to its skeletal predecessor of U.S. *Code*, but states are tailoring the law even further. We turn now to that stage of the rulemaking process.

States Define Procedures for Localities

States are given explicit authority to define procedures relating to state-level implementation of federal laws. While the EPA rule on Consumer Confidence Reports requires states to define how water systems will distribute the reports to their customers, and the EPA rule requires a "good faith effort" to inform water customers and offers suggestions, it is up to states either to clarify publication guidelines or to follow a predetermined set of federal guidelines. In the case of the Consumer Confidence Reports, the states have two years from when the final rule was put into effect to complete their regulations.[7]

In Virginia, officials at the Department of Health lead the state implementation process. Hugh Eggborn, an engineering field director in the health department's Office of Water Programs, has the informal title (he says) of "Consumer Confidence Rule manager for Virginia." He chairs the department's Consumer Information Team, which includes health department staff members, water utility officials, and members of water utility organizations (such as the Virginia Rural Water Association and the Virginia chapter of the American Water Works Association). The team's job is to plan how to implement the Consumer Confidence Report rule throughout the state. The team met several times in 1998 after the EPA's proposed rule and final rule came out. "We outlined a plan and are scheduling workshops to help community water systems learn the requirements of the [final rule]," Eggborn said.

---

[7] States are responsible for enforcing the 1996 Amendments to the SDWA, but that authority is based on a conditional agreement with EPA. In order to retain enforcement power (known as **primacy**), states must write regulations that are at least as stringent as the federal ones. Otherwise, EPA may take over enforcement.

Implementation by Water Systems

Once a rule has made its way through the regulatory maze of federal and state government, it's up to people at the local level to put the law into action. Although federal and state officials will have already put their mark on the rule, there may still be some room for local touches. In the case of the Consumer Confidence Reports, certain information is required, but water systems may tailor their report's structure to fit their community. The reports may also offer additional information about the water system, such as names of employees and their responsibilities to the public.

In preparation for sending out their reports, water system operators across the state are making decisions on how to create and distribute the reports. Various public and private groups are offering ways to help water systems do so. As mentioned above, the state health department will be conducting free workshops for water systems, geared especially toward smaller water systems. The health department is also offering one-on-one consultations up through the October 19, 1999, deadline in order to help communities deliver the reports on time. The Virginia Section of the American Water Works Association is also offering workshops (please see the Notices section of this issue of *Water Central* for more information on these workshops). The U. S. EPA and the National Rural Water Association are both developing computer templates for producing the reports (a standard format into which water systems can insert their information).

To get a local perspective on this upcoming federal requirement, we spoke with Joyce Creel of United Water Virginia, Inc., a private water utility in the Northern Neck. This small business, with only eight employees, serves about 2,000 residential water customers in Essex, King William, Westmoreland, Northumberland, and Lancaster counties. Groundwater is main source of drinking water for the area and many people rely on private wells.

United Water operates 17 individual systems, which translates into 17 individual Consumer Confidence Reports they must produce. Because they serve so few customers, however, they will be able to forego the mailing requirement and publish their reports in the local newspaper. But even that might have its challenges, Ms. Creel said, because a single weekly newspaper serves the area and 17 reports in one issue may be too cumbersome. At this point, she and others in the company are debating additional ways to inform their customers, such as keeping copies of the report at the office for customers to pick up.

Ms. Creel said she would be relying on help from the state health department to create her company's reports. Right now, the company is gathering information and preparing to put it into a report format. "It's a long process," Creel said. "We're hoping the health department will come through with the software [for a standard format]."

Implementation, Then Impact

It may take years, but ultimately federal legislation affects individual citizens. Despite the study, debate, and revision that goes into rulemaking, the day-to-day results of a rule in action are not completely predictable, because the final impact depends on how citizens respond. For the Consumer Confidence Reports, the final implementation step will be when the report reaches the customer's mailbox. The *U. S. Code* doesn't control what customers do after that.

Additional Resources

Additional information about the SDWA and EPA's Drinking Water Program may be obtained by calling the Safe Drinking Water Hotline at (800) 426-4791, or from the EPA Office of Groundwater and Drinking Water's web site: **www.epa.gov/safewater**.

For more information about Virginia's implementation of the Consumer Confidence Reports, phone Hugh Eggborn, VA Dept. of Health's Office of Water Programs, at (540) 829-7340.

–By Lisa Garcia

SCIENCE BEHIND THE NEWS

Why Do You Study *That*? (An Introduction to Water-related Sciences)

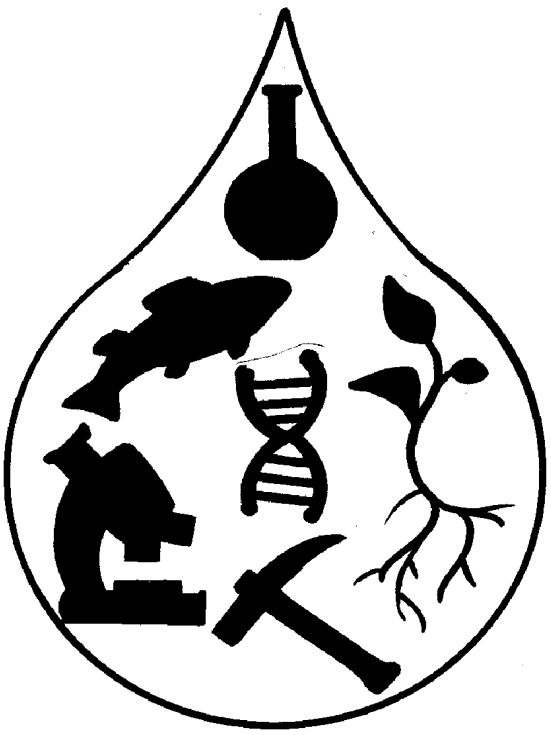
Imagine yourself at a literacy fund-raising spelling bee in Montgomery County, Virginia, in the early 1990s. A confident team of newspaper reporters needs only one more correct spelling to secure first place. Their confidence dissolves into confusion, however, when the moderator enunciates their word: "lim-NOL-o-gee." As spectators rush for dictionaries, the team makes an understandable—but wrong—guess that it might be "limbnology," perhaps the study of arms and legs. To the reporters' dismay, they learn that they have been tripped up by the relative obscurity of *limnology*, the scientific study of lakes, streams, and other inland waters. Amid the audible grumbles of "Whoever heard of *that* science?" rising up from the journalists' table, the moderator solemnly says, "Woe to those who know nothing of the sciences behind the news!"

Back in the present, the "Science Behind the News" series seeks to prevent such "woe" for people who follow water-related news. The series presents basic scientific information, concepts, or methods that are relevant to current water issues. In doing so, *Water Central* hopes to enhance people's understanding of the scientific aspects of water news, enabling them to them make more-informed choices as citizens.

As a foundation and reference for the series, this issue identifies and describes 19 sciences that are important to water resources. This group of sciences certainly does not include *every* field of study that involves or affects water—an undertaking that would require a hefty book, because water is so widespread and is essential to life on earth. To narrow the scope somewhat, the focus here is on only those sciences and issues that relate to water quality, drinking water, or living things in aquatic environments. (Less attention is given to water *quantity* issues, related to practices and technology used to supply, move, or treat water). Even restricting the discussion to these three topics, many more fields of study could rightly be included in a summary of water-related sciences. For example, the following fields of study, which are *not* described in this article, often involve water or provide principles or methods used in water-related fields:

> agriculture, animal behavior, biophysics, cell biology, economics, engineering, forestry, mathematics, medical sciences, molecular biology, psychology, sociology, statistics, and virology.

Despite mentioning these fields in addition to the ones described in the next section, I have probably still overlooked some important areas. Sincere apologies, therefore, to anyone who, after reading this article, feels their area of interest has been unfairly neglected.



A World of Science in a Drop of Water

Who Knows What Science Lurks…

1. Biochemistry—the study of the chemical aspects of biological structures and processes. "Biological chemistry" emerged as a new discipline in the late 19th Century, and during the 20th Century it has revealed "both the structural basis of living organisms and how chemicals are transformed within them…."[8] Thousands of biochemical reactions allow living things to carry out vital biological processes, such as photosynthesis, where plants use sunlight to make food. Because substances can move between water in the environment and the fluids in living organisms, an organism's *biochemistry* is subject to the *chemistry* of the substances in the water it inhabits, ingests, or enters. (See below for more on chemistry.)

2. Biology—the study of living things. Modern biology, with its emphasis on laboratory experimentation, emerged in the 20th Century from two scientific roots: the field- and classification-oriented sciences of botany and zoology; and the medically oriented fields of anatomy and physiology. Today, biology refers to a number of related **biological sciences**, including biochemistry, cell physiology, embryology (the study of development), genetics, and others (biochemistry and genetics are described in this article).

Aquatic Biology is concerned specifically with living things in ponds, streams, and other water environments. Typically aquatic biology focuses on freshwater systems. **Marine Biology** studies living things in the oceans or in systems influenced by the oceans, such as tidal estuaries. **Fisheries Biology** involves the study and management of aquatic systems that provide economically valuable fish or other aquatic animals. **Forest Biology** focuses on living things in environments dominated by trees. Trees and associated organisms are often closely linked to the state of water resources, because trees typically make up some part of the drainage areas of many freshwater systems, and trees border many streams and lakes.

3. Botany—the study of plants. Botany is an old science, dating back at least as far as the Greek scientist Dioscorides (*circa* 40-80 AD) who did a systematic study of medicines derived from plants. Along with zoology, botany was a traditional and fundamental area of natural history from which various biological sciences developed.

Aquatic Botany is concerned primarily with plants that live in ponds, streams, lakes, and marshes. An important focus of aquatic botany is plants whose presence indicates that an area is, or might have been, a *wetland*.

4. Chemistry—the study of the structure of substances, their properties, and the reactions between substances. The modern science of chemistry dates back to John Dalton's (1766-1844) ideas of atoms, but the *practice* of chemistry has roots in ancient civilizations' work with metals, medicines from plants, and other activities.

Environmental Chemistry is the study of the properties and reactions of substances in water, soil, or the air. Environmental chemistry also involves the effects of human activities on chemicals in the environment. Any news articles involving human-produced chemicals in water resources will involve some aspect of environmental chemistry.

Water Chemistry refers less to an area of study (although it can be used this way) than to the actual properties of water. Water's unique properties are the key to understanding how water is so important to life on earth and how various activities can affect water quality.

5. Ecology—the study of the relationships among living things and between living things and their non-living environment. The science of ecology seeks to describe, measure, and analyze such relationships. In practice, one can study "the ecology"—that is, the ecological relationships—of a particular area (such as an individual lake), of certain types

[8] Borell, Merriley. 1989. *Album of Science—The Biological sciences in the Twentieth Century.* Charles Scribner's Sons, New York.

of areas (such as ocean ecology), or of a certain group of organisms (such as fish ecology). The term **ecosystem**—coined in 1935 by a British scientist—refers to a given area along with its the living and non-living components and their interactions.

6. Entomology—the study of insects. That raises the question, what exactly is an insect? Among the one million or so kinds of insects worldwide, and even among the 20,000 or so kinds found in Virginia, there is incredible variety of size, color, shape, and living habits. But all insects show the following three characteristics *at some point in their life cycle*: a body divided into three main segments, three pairs of jointed legs, and a tough outer covering (their exoskeleton).

Aquatic entomology is, the study of insects that inhabit aquatic systems. Some kinds of insects spend their whole life cycle in the water, while others do so only prior to becoming an adult. In either case, such insects can be valuable indicators of water quality.

7. Genetics—the study of how organisms inherit and express biological characteristics. The fundamental genetic substance in all living things is **DNA** (deoxyribonucleic acid), so whenever DNA is discussed in relation to water resources (or any other topic), genetic principles are involved.

8. Geography— "the study of the earth and its peoples in their interrelationships and spatial variations…. Geographers study why things are where they are, when and how they got there, and the processes and forces that shape these patterns."[9] Topics within the scope of geography include the earth's physical features, including water features; patterns of human settlement, which typically depended on access to water; and the relationship of environmental problems, including water-related ones, to societies and where they are located.

9. Geology—"the science of the earth."[10] Obviously the earth is a broad subject, but geology's basic aspects include the study of the planet's physical structure; the properties of rocks and minerals, the building blocks of that structure; and the processes that change the earth's structure, such as erosion, volcanic activity, and the movement of the continents. Just as biology has branched over time into diverse biological sciences, geology itself is only one of many **geological sciences**, ranging from the relatively broad (such as geochemistry) to the quite specific (such as palynology, the study of microscopic plant fossils).

10. Hydrology—the study of the interactions of water with its environment as it moves through the **water cycle**. Hydrology involves how much water there is, where it is, how it gets there, and what happens along the way. (Note: Please see the December 1998 issue of *Water Central* for more on hydrology.)

11. Ichthyology—the study of fish, specifically their structure, physiology, classification, and distribution. In other words, if you see a fish, and you'd like to know what kind it is, what habitat it prefers, what it eats, when and how it breeds, or whether it has ever been found in your home county—ask an ichthyologist! (Note: Please see the October 1998 issue of *Water Central* for more on fish.)

12. Limnology—the study of lakes, streams, and other inland waters (as noted in the opening anecdote of this article). "Inland waters," rather than "fresh waters," is used because limnology encompasses studies of salty inland waters, such as the Great Salt Lake. The science originally focused on lakes, but limnologists today study a wide variety of aquatic systems—from "prairie pothole" lakes in North Dakota to drainage ditches in Illinois to the James River in Virginia. A commonly seen aspect of

[9] From the 1998-99 Virginia Tech Undergraduate Catalog, pages 129-30.

[10] Flint, Richard Foster and Brian J. Skinner. 1977. *Physical Geology*. 2nd ed. John Wiley & Sons, New York.

limnological studies—besides that they are *not* studies of the oceans—is an emphasis on how much living material is being produced by a given aquatic system, and the physical, chemical, and biological factors that determine this production.

13. Meteorology—the study of the atmosphere, weather, and climate. "Weather" is the state of the atmosphere affecting the earth at any one instant or over a short period of time, while "climate" refers to long-term differences in weather among different regions of the earth.

Climatology is the study specifically of climate.

14. Microbiology—the study of bacteria, viruses, and other microscopic organisms (or "microbes"). Microbiology encompasses the field of **bacteriology**, which developed in the 19th Century as biologists discovered bacteria to be the causes of certain diseases (such as water-borne diseases like typhoid fever and cholera) as well as of various beneficial activities (such as fermentation of foods). (Note: Please see the August 1998 issue of *Water Central* for more on microbiology.)

15. Mycology—the study of **fungi**. Fungi (singular is "fungus") are a diverse group of organisms that get their food from non-living organic material (although some fungi are parasitic on living organisms). The group includes molds, yeasts, mildews, mushrooms, and other organisms. Although some fungi, such as mushrooms, seem plant-like, fungi are not classified with the true plants. In both aquatic and terrestrial environments, fungi are widespread, essential to recycling of nutrients, and important as disease-causing organisms.

16. Phycology—the study of **algae**. Algae (singular is "alga"), like fungi, are a large group of varied organisms that at one time were classified as plants but are now considered fundamentally different from plants. The group includes what people call "pond scum," "seaweed," "kelp," and many other traditional names, as well as many microscopic species. Unlike fungi, algae can make their food through photosynthesis. Algae are important in aquatic systems as food, as oxygen producers, and as potential problems if certain kinds grow excessively. (Note: Please see the June 1998 issue of *Water Central* for more on algae.)

17. Soil science and **sediment science**—As any soil scientist will quickly tell you, soil is more than "dirt." Soil is a complex mixture containing not only broken-down rocks and minerals (the "dirt" part), but also air, water with dissolved substances, living organisms, and decaying organic matter (from *formerly* living organisms). **Sediments** are materials that have been picked up from one place by water, wind, or other means and deposited somewhere else, including in streams and other aquatic environments. As with soil in a terrestrial environment, the characteristics of the sediment in an aquatic system greatly affect the physical and chemical features available to the living things in the system.

18. Toxicology—the study of substances that are, or could be, poisonous to humans or other organisms. The science of toxicology involves the biological effects of toxic substances, the environmental pathways by which living things can be exposed to substances, and the development of feasible methods for evaluating the potential hazards posed by given substances. This field has grown significantly as modern, industrial societies have developed and put to use thousands of chemicals.

Aquatic toxicology deals specifically with the sources, movements, and effects of toxic substances in aquatic environments.

19. Zoology—the study of animals. Zoology historically has had four main concentrations: classification, anatomy, physiology, and development. Zoologists working within one of these concentrations typically focus also a particular *group* of animals. The three following broad groups encompass all animals, including aquatic animals:

protozoa—single-celled animals;
invertebrates—animals without a backbone, such as worms and insects (the

vast majority of animal species are invertebrates)

vertebrates—animals with a backbone, including fish, amphibians, reptiles, birds, and mammals.

…What Science Lurks in the Headline of a News Story?

The "Science Behind the News" series is intended to help non-scientists become more informed about how science is involved in water-related issues, especially as reported in the various news media. Sorting out *how* science affects a water issue begins with recognizing *what* science might be involved. If you know that, even if you have no particular knowledge of the science, at least you will know what kind of information or professional person to seek out for help.

For a bit of practice, try identifying one or more water-related sciences involved in the articles headlined on the following page. A set of possible answers follows the list, but you may come up with other acceptable ones. There are no penalties for wrong answers in this puzzle, but don't get lackadaisical: you never know when a water science will turn up in the news, a public meeting, or an important spelling bee.

References and Further Reading

Borell, Merriley. 1989. *Album of Science—The Biological sciences in the Twentieth Century.* Charles Scribner's Sons, New York.

Magner, Lois N. 1994. *A History of the Life Sciences.* 2nd ed. Marcel Dekker, Inc., New York.

Manahan, Stanley E. 1994. *Environmental Chemistry.* 6th ed. Lewis Publishers, Boca Raton, Florida.

Riehl, Herbert. 1978. *Introduction to the Atmosphere.* 3rd ed. McGraw-Hill, New York.

Webster's Seventh New Collegiate Dictionary. 1967. G. & C. Merriam Co., Springfield, Massachusetts.

Like most fields of study, the sciences listed in this article have one or more publications, called **journals**, where researchers in the field publish their work, following a critical review by others in the field (this is called **peer review**). The information in these journals constitutes the **"literature"** of the field. The following is a *tiny* sample of the *many* scientific journals related to water:

Canadian Journal of Fisheries and Aquatic Science; Contaminant Hydrology; Journal of Applied Meteorology; Journal of Experimental Botany; Journal of Experimental Zoology; Journal of Phycology; Lake and Reservoir Management; Limnology and Oceanography; Water Environment Research; Water Science and Technology.

A Current Virginia Example of Sciences Behind a Public Issue: The Smith Mountain Lake Water Quality Task Force

In 1998, the Policy Advisory Board for Smith Mountain Lake (a large Roanoke River reservoir in Bedford, Franklin, and Pittsylvania counties in Virginia) created a water-quality task force to study issues related to the lake's current and future water quality. The committee grouped the issues around five major topics: 1) erosion and sedimentation; 2) fish, wildlife, and recreation; 3) public health; 4) water-quality monitoring; and 5) water supply/wastewater treatment. The specific issues in these five areas involve many scientific fields, including *at least* the following:

animal behavior, biochemistry, biology, botany, chemistry, ecology, economics, engineering, forestry, hydrology, ichthyology, limnology, medical sciences, microbiology, phycology, sociology, soil and sediment science, toxicology, and zoology.

–Alan Raflo, Water Central editor.

Water Central thanks Roger Bachmann (Department of Fisheries and Aquatic Sciences, University of Florida) for reviewing this article.

Water Sciences Puzzle

Of the sciences described in this article, choose one that relates to each of the following news headlines.

1. "Research [in Israel] Shows Water Lilies as Water Purifiers," *PR Newswire*, 1/15/99.
2. "Spanish Mine Zinc Spill Contaminates River to High Acidic Levels," *Earth Times News Service*, 10/20/98.
3. "Patapsco River Fish Kill Points to Cold Weather," *Baltimore Sun*, 1/8/99.
4. "No One is Happy with Sinkhole Deal," *Roanoke Times*, 1/4/99.
5. "Sediment in Albemarle, Pamlico Sounds Contaminated," *AP*, 10/26/98.
6. "Ozone Kills Germs in Water, But is it Enough?" *Boston Globe*, 10/27/98.
7. "Fungus Blamed for Fish Sores," *AP*, 10/22/98.
8. "Mighty Rivers Run Dry, Hobbling China's Economy," *Washington Post*, 10/2/98.
9. "Scientists: Acid Rain Threatens State Brook Trout Population," *AP*, 9/9/98.
10. "Scientists Study Unwelcome Algae," *AP*, 8/16/98.
11. "Amoeba Infects, Kills Boy in Florida," *AP*, 8/8/98.
12. "DNA Test May Help Get Drop on Waste," *Arlington Journal*, 7/30/98.
13. "Suitland Bog—An Insect's Worst Nightmare," *Prince George's [Maryland] Journal*, 5/20/98.
14. "Loch Haven Declared 'Healthy' Reservoir," *Baltimore Sun*, 11/19/98.
15. "Scientists See Possible Link Between Pesticides, Deformed Frogs," *AP*, 3/23/98.

Bonus for the "Advanced" Reader! "Corrosion Controlled with Carbon Dioxide Addition." *Opflow*, Vol. 25, No. 1, January 1999 (American Water Works Association).

Answers to Water Sciences Puzzle: 1—aquatic botany; 2—environmental chemistry; 3—ichthyology; 4—geology; 5—soil/sediment science; 6—microbiology; 7—mycology; 8—geography; 9—aquatic toxicology; 10—phycology; 11—(protozoan) zoology; 12—genetics; 13—entomology; 14—limnology; 15—biochemistry; **Bonus**—water chemistry.

A Recent "Science Behind the News" At Work

On the Track of the Global Water Cycle

Hydrology, the "science behind the news" featured in the December 1998 issue of *Water Central*, is the focus of the Global Energy and Water Cycle Experiment, a worldwide research project that seeks a better understanding of the global water cycle. An article in the November/December 1998 newsletter of the Water Science and Technology Board states that understanding "the full cycle of evaporation, cloud formation, and precipitation" is a key part of predicting potential climate changes and their possible effects. According to author Joe Friday, director of the National Research Council's Board on Atmospheric Sciences and Climate, a better understanding of the hydrologic cycle, especially of water vapor, can also lead to better estimates of seasonal or annual precipitation and to better forecasts of severe weather. This global research project's objectives highlight three common activities of scientists at work:

1) *measure* the global hydrologic cycle and its related energy changes;
2) *model* the global cycle and its effects on the atmosphere, land, and oceans; and
3) develop the ability to *predict* variations in the global cycle.

IN AND *OUT OF* THE NEWS
Newsworthy Items You May Have Missed

The following summaries are based on information in the source or sources indicated at the end of each item. Selection of this issue's items concluded January 21, 1999.

If you have access to the Internet, you can follow water-related news with the "Daily News Update" at the Water Center's Web site (the Web address is listed on the last page of this newsletter).

•A **$2.7-million grant** to the Virginia Department of Environmental Quality (DEQ) will fund 47 projects in the **Virginia Coastal Resources Management Program**. The grant, from the National Oceanic and Atmospheric Administration, will match funds for projects by state agencies, planning district commissions, and Tidewater localities. Among the grants, which cover the period October 1998 to September 1999, are $125,000 to the Virginia Department of Conservation and Recreation to acquire land on Virginia's Eastern Shore as a refuge for migrating songbirds; $20,525 to Gloucester County for a natural-heritage inventory of the Dragon Run watershed; and $45,000 to the Hampton Roads Planning District Commission for its technical-assistance program. For more information about the Coastal Resources Management Program, call Virginia Whitmer at (804) 698-4320. (*Virginia DEQ Regulatory Update*, Nov. 1998)

•When the plan is fully implemented in 2003, the U. S. **EPA's 1998 action to curb nitrogen oxide air emissions** in 22 states will reduce the amount of airborne nitrogen reaching the Chesapeake Bay by an estimated eight million pounds per year; that amount equals about 11 percent of the multi-state Bay Program's overall nitrogen-reduction goal. (Excessive nitrogen contributes to several water-quality and habitat problems in the Bay.) A coalition of utility and fuel companies, however, has filed a petition with the U. S. Circuit Court of Appeals, saying the EPA rule places unfair burdens on utilities. Several states have also filed appeals. (*Bay Journal*, Nov. 1998)

•Dams trap two-thirds of the sediment and two-fifths of the phosphorus flowing down the **lower Susquehanna River** each year, according to a U. S. Geological Survey report. In the process, the reservoirs behind the dams slowly fill with the trapped material. According to the report, between 2010 and 2015, some of these reservoirs will reach their capacity for trapping these amounts of sediment. If no corrective action is taken, this could result in estimated annual increases of 250 percent in the sediment and 70 percent in the phosphorus reaching the Chesapeake Bay. (*Bay Journal*, Dec. 1998)

•The city of Jacksonville, located on Wilson Bay near the coast of North Carolina, is seeking $500,000 in state funds to **use shellfish to clean wastewater.** More than a million oysters, clams, and mussels would be placed in the bay, where their natural water-filtering processes would be harnessed to remove sediment, algae, and bacteria. An adjacent sewage-treatment plant, which closed recently, would become a preserve for sturgeon, the fish whose eggs are prized as caviar. Two species of sturgeon live in the Atlantic and enter coastal fresh water to spawn, but sturgeon populations have declined. (*Raleigh News & Observer*, 12/10/98)

•After 65 years of near-complete absence, a **colony of bay scallops** has been sighted **near Chincoteague, Virginia**. Some people blame the scallops' demise on a 1933 hurricane that destroyed eelgrass beds in which scallops live. But such underwater grasses have been recovering and spreading in recent years. The discovery has encouraged scientists to discuss trying to re-establish scallops in the area. (*Roanoke Times*, 12/28/98)

•Virginia has matched a **$7-million federal grant aimed at keeping Richmond's sewage out of the James River**. The first installment, $3.5 million, will be used to start renovation of the city's antiquated sewer system, which can overflow and spill into the James during heavy rains. Lynchburg has received a grant for a similar project. (*Richmond Times-Dispatch*, 12/30/98)

•Along U. S. coastlines, the federal government and local port authorities are spending billions on **dredging to remove sediments and deepen waterways** for a new generation of 1,000-foot-long cargo ships. Along with cities like New York and Philadelphia, three Virginia ports are being dredged to create an additional five feet for ships needing at least 50 feet of clearance. Environmentalists, however, have raised concerns that these projects could damage marine habitats or release toxins that might get into aquatic food chains or groundwater supplies. (*Associated Press*, 1/2/99)

•**An unusually high number of water-main breaks** besieged northern Virginia and Washington, D.C., during the erratic temperature shifts of early January. In Washington, crews worked 12-hour shifts to repair a backlog of more than 130 breaks that led to slippery roads, snarled traffic, and serious accidents. A break in the only pipeline bringing water from the Shenandoah River to Winchester lowered city water levels so drastically that city officials declared a state of emergency. In the Loudoun County town of Middleburg, where water supplies were already strained by the late-1998 drought, a water main rupture drained the town water tanks, and citizens were asked to conserve water for a week while the tank was refilling. (*Washington Post*, 1/13/99; *Associated Press*, 1/13/99; and *Leesburg Today*, 1/4/99)

•A new federal allocation of $2 million will be used to purchase more wetlands and riverside forests for the **Rappahannock River National Wildlife Refuge.** The preserve, which has been in the works since 1994, will encompass 20,000 acres scattered over seven counties along the lower Rappahannock. The money will come from the Land and Conservation Fund of the U. S. Department of Interior and will be purchased by the U.S. Fish and Wildlife Service. (*Fredericksburg Free-Lance Star*, 1/15/99)

•**South Carolina officials are hoping the state's first pump-out boat** will make the state's coastal waters cleaner. The 21-foot, $34,000 boat—bought in part with a federal grant—is intended to make it more convenient for boaters to pump out their crafts' sewage-holding tanks, reducing the temptation to empty tanks offshore (legal at three miles or more) or in coastal waters (illegal). (*Associated Press*, 1/20/99)

•**Trees may help clean up a landfill** in southeastern Ohio (Hocking County). Environmental officials want to plant hybrid poplars in an old landfill where industrial wastes were once dumped; the tree roots would take up contaminated water from within the dump. In this process, called phytoremediation, an acre of 300 mature poplar trees would consume an estimated 3,000 to 10,000 gallons of leachate a day. Such a cleanup, if effective, would be less expensive than installing a clay cap and a pump-and-treat system, the usual methods of cleaning up polluted groundwater. Similar proposals recently have been advanced at polluted sites around the country. (*Akron Beacon Journal*, 1/21/99)

•**Drought update**—Mid-Atlantic citizens were asked to conserve water, municipalities began looking for other water sources, arborists reported widespread tree damage, and wildlife began venturing closer to suburbia in search of greener habitats, as the effects of the drought that began in July 1998 lingered into 1999. Significant rainfall finally returned in late January, replenishing reservoirs and allowing removal or water-use restrictions in many localities. (*Winston-Salem [NC] Journal*, 12/16/98; *Washington Post*, 12/27/98 and 1/20/99; *Bergen [NJ] Record*, 12/29/98; *Associated Press*, 1/15/99)

–Compiled by Su Clauson-Wicker

N O T I C E S

Workshops on Consumer Confidence Reports

The American Water Works Association (AWWA) and the Water Center are co-hosting a workshop for water system staff on Consumer Confidence Reports, **March 26 in Blacksburg**, 8:30 a.m. to 3 p.m. AWWA handouts will include a copy of the *Federal Register* regulations on CCRs, a handbook, sample reports and news releases, and more. The cost is $50 for AWWA members, $90 for non-members. The workshop will also be held on **March 12 (Newport News)** and **April 2 (Stafford)**; registration deadlines are two weeks prior to the workshops. For more information or to register, contact Annette Pebler, CH2M Hill, P. O. Box 4400, Reston, VA 20195; (703) 471-6405, ext. 4101.

U. S. EPA Public Hearings on Virginia's TMDL List

The U. S. EPA has rejected part of Virginia's list of impaired waters needing establishment of Total Maximum Daily Limits (TMDLs) of pollutants (for an explanation of TMDLs, see the Feature in the October 1998 *Water Central*). EPA will hold two public hearings on what waters should be included in Virginia's current list: **March 10**, 7 p.m., Virginia Department of Motor Vehicles, 2300 West Broad Street, Richmond; and **March 11**, 7 p.m., Roanoke County Administration Center, 5204 Bernard Drive, Roanoke. Written comments will be accepted until **March 15**. For more information, including a copy of the document detailing EPA's disapproval and a list of the additional waters EPA is considering, contact Ms. Lenka Berlin at (215) 814-5259, or e-mail: berlin.lenka@epamail.epa.gov.

Sinkholes/Karst Conference

The 7th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Aspects of Karst™ will be held **April 10-14**, 1999, near Harrisburg, Pennsylvania. The conference will include an introductory course on karst geology and hydrology. The conference is organized by P. E. Lamoreaux & Associates (PELA) in conjunction with various organizations, including the Water Center. For more information, contact Gayle Herring, PELA, 106 Adminstr. Rd., Oak Ridge, TN 37830; (423) 483-7483; or pelaor@usit.net.

New River Symposium

The biennial New River Symposium, co-sponsored by the Natural Park Service and the West Virginia Division of Culture and History, will be held **April 15-17**, 1999, in Boone, North Carolina. For more information, call (304) 465-0508.

At the Water Center

•The VWRRC has issued the following funding announcements for 1999:

Undergraduate Research Summer Fellowships, deadline **March 8**;

William R. Walker Graduate Research Fellowship; Seed Grants; and Competitive Grants, all with a deadline of **March 29**;

U. S. Geological Survey National Competitive Grants to support research on nonpoint source pollution. Any investigator at a Virginia college or university is eligible to apply for a grant through the Water Center; deadline **April 23**.

For more information or application materials on any of these opportunities, contact Tamim Younos at (540) 231-8039, or e-mail: tyounos@vt.edu; or use the Center's Web site, www.vwrrc.vt.edu/vwrrc/vwrrc.htm.

•Two new **Water Center Special Reports** are now available:

Long-Term Water Quality Trends in Virginia's Waterways;

Methods for Measuring and Assessing Nonpoint Source Pollution Control at a Regional Stormwater Management Facility.

Virginia residents may receive one free copy of these publications, while supply lasts, from the Water Center at 10 Sandy Hall (0444), Blacksburg, VA 24061; (540) 231-5624; e-mail: water@vt.edu.

FOR THE RECORD
Sources for Selected Water Resources Topics

Groundwater Information Sources

The Virginia Ground Water Protection Steering Committee is a good starting point for general information or for sources of more specific data. Contact Mary Ann Massie, Department of Environmental Quality (DEQ), at (804) 698-4042; or visit the Committee's Web site at **www.deq.state.va.us/gwpsc/home.html**.

Useful Publications

•From the Water Center:
1) *1997 Karst-Water Environment Symposium*;
2) *A Guide to Virginia's Groundwater*; and
3) *A Guide to Protecting Virginia's Valuable Resource: Ground Water*.

Publications 1 and 2 are currently out of print, but photocopies are available at 15 cents a page (42 and 30 pages, respectively); non-Virginia residents are charged an additional $5.00. Call 540-231-5624, or send e-mail to water@vt.edu.

•From the U. S. Geological Survey (USGS): *Water Resources Data-Virginia*. The 1997 report included records of water levels at 329 wells and groundwater quality at 88 wells. This report should be available at many libraries; for your own copy, write to District Chief, Water Resources Division, USGS, 3600 West Broad St., Room 606, Richmond, Virginia 23230.

Potentially Useful Data Sets

•At the VA DEQ regional offices:
1) files documenting pollution-complaint investigations, spill-response reports, and underground storage tank releases;
2) "**ambient groundwater quality monitoring"** files (now discontinued): physical and chemical measurements from wells and springs, collected from the mid-1970s through about 1991. *DEQ cautions that these data have not been processed or evaluated.*
•From Virginia Health Dept. county offices: **water-well completion reports**, with basic information about new wells, public or private.
•From other local groups: Several Soil & Water Conservation Districts collect groundwater quality data. In addition, data for particular watersheds or streams may be available from local volunteer monitoring groups.

Your Own Private Well

If you use a private well and wish specific information about the water, it is up to you to have the water tested.

—Compiled by Terri Brown (Virginia Dept. of Conservation and Recreation) and Dinesh Gupta (VA Tech intern at the Water Center).

"For the Record" Schedule

1999
This issue – Groundwater Information Sources
April – Weather and Climate Information Sources
June – Water Uses Information Sources
August – Water Maps: Types and Sources
October – Wetlands Information Sources
December – Water Law Sources

Schedule subject to change

TEACHING WATER
For Virginia's K-12 teachers

This Issue and the Virginia Standards of Learning

Water Central welcomes comments on the applicability of these articles to the standards listed or to others not listed.

Abbreviations: **BIO**-biology, **ES**-earth science, **LS**-Life science; **CH**-Chemistry

"Flow of Federal Water Laws"
Science: 6.11, LS.12, ES.7.
Social Studies: 7.2, 7.4, 12.7, 12.8, 12.10.

"Introduction to Water-related Sciences"
Science: 2.6, 3.9, 3.10, 4.5, 4.8, 5.5, 6.5, 6.7, 6.8, 6.9, 6.11, LS.6, LS.7, LS.12, ES.2, ES.8, ES.9, ES.11, BIO.2, BIO3, CH.6.
Social Studies: 7.9.

"For the Record—Groundwater Information"
Science: 3.9, 3.10, 4.8, LS.12, ES.7, ES.8, ES.9.
Social Studies: 10.9, 10.10, 11.15, 12.9, 12.13.

Virginia Water Central

Published bimonthly by the Virginia Water Resources Research Center, 10 Sandy Hall (0444), Blacksburg, VA 24061; (540) 231-5624; fax (540) 231-6673; e-mail: water @vt.edu; Leonard Shabman, director.

Water Central staff: Alan Raflo, editor; Lisa Garcia and Su Clauson-Wicker, writers; George Wills, illustrator.

Reminder!! *Water Central* will be posted on the Water Center's web site (**www.vwrrc.vt.edu/vwrrc/vwrrc.htm**). If you prefer to read the newsletter there, *instead of* receiving a paper copy, please send your e-mail address to water@vt.edu, and we will notify you when a new issue is posted.

YOU GET THE LAST WORD

Please answer the following questions to let us know whether the newsletter is meeting your needs. Please mail this page to the Water Center address listed in the box to the left, or e-mail your responses to water @vt.edu. Thank you.

1. Would you rate the **content** of this issue as good, fair, or poor?

2. Would you rate the **appearance** as good, fair, or poor?

3. Would you rate the **readability** of the articles as good, fair, or poor?

4. Do you approve of the newsletter **name**? If not, please suggest an alternative.

5. Please add any other **comments** you wish to make.

Virginia Water Resources Research Center
10 Sandy Hall (0444)
Blacksburg, VA 24061

Non-profit Org.
U.S. Postage Paid
Blacksburg, VA 24060
Permit #28

Printed on recycled paper

VT/348/0299/2.7M/992925