

School of
ENVIRONMENT & NATURAL RESOURCES

Dear Interested Career Ambassador,

The Environmental Education Council of Ohio (EECO), Ohio EPA Office of Environmental Education and the Ohio State University would like to thank you for your interest in becoming an Environmental Career Ambassador (ECA). These Ambassadors are Environmental professionals willing to make classroom or school career fair presentations for middle and high school grades about their careers, and/or provide shadowing, internship, field trip and scholarship opportunities to Ohio students.

We are thrilled to offer this because Ohio students, teachers and guidance counselors need assistance exploring the wide range of careers available in environmental science and engineering, or the specialized training and skills required.

If you have not already signed up to play a part in this worthwhile program you can sign up at: <http://epn.osu.edu/> and fill out the ECA information.

Attached is a tool kit that has been created to assist you as a Career Ambassador to actively engage middle and high school students. Feel free to adapt these activities to fit your audience and location. There are also other resources through EECO such as Regional Directors that can help make presentations, or books and groundwater flow models that you can borrow. You can get contact information for your region through the EECO website at www.eeco-online.org or you can email the Executive Director at director@eeco-online.org for more information. We are here to help you!

Above all please know how much we appreciate you taking the time out of your busy schedule to help excite Ohio students in the world of Environmental Careers!

Sincerely,

Brenda Metcalf
Executive Director, Environmental Education Council of Ohio

Tips for Career Day Speakers

Things to include in your presentation:

- A brief history/background of yourself that led to your current career or job
- Description and responsibilities of your career/occupation
- Education/training required – (please emphasize the importance of life-long learning)
- Skills needed, i.e. good communication skills, hand-eye coordination, etc.
- Positive and negative aspects of your career/occupation (e.g., you like working outdoors)
- Salary range/pay (and benefits, as applicable)
- Any extracurricular activities in school and how they may have helped you
- Time for Q & A

Questions you might get from students:

- What are the major duties/responsibilities of your job?
- What character traits/work habit do you or your employer expect an employee to have?
- What training/education is required for this job?
- What other jobs/people depend on your job getting done?
- What are the “normal” hours of your job? If there is overtime, how much/often?
- What types of demand (physical, mental, emotional) or hazards, if any, are involved in your job?
- What specific types of tools, equipment, and/or technology do you use on a regular basis?
- What led you to this job/career? If you have/had a role model or mentor, please tell me about them.
- What do you like most about your job? The least?
- What courses in middle/high school would help a student prepare for your job/career?
- What extra-curricular activities, volunteer work, and/or part-time job might help someone prepare for your job?
- What changes, positive and/or negative, have taken place in your job/career recently or since you started?
- How much have these changes affected you and/or your career?
- What do you think your job/career will be like in ten years?
- What is the employment outlook for this field of work and/or how difficult is it to find your type of job?
- What other occupations are related to your job/career?
- What advice would you give a student who is considering your type of job/career?

Remember that middle school students respond well to hands-on, interactive, show-and-tell type information and presentations. Show them equipment you use, safety gear you wear, and examples of problems you try to solve.

Our thanks to Tom Markle, longtime Career Day coordinator at Walnut Springs Middle School in Westerville, for these tips.



SHARING SCIENCE WITH CHILDREN:

A Survival Guide for Scientists and Engineers

The Task . . .

We face a challenge. Our children need to learn about rapidly changing science and technology. Already, many of your colleagues, along with educators, parents, and local, state, and national organizations, have joined together to meet the challenge. They support science education by allocating resources, building community support, and providing tools and materials for teachers.

You can help. One of the best tools any teacher can have is a person who knows and understands science and technology — a person like you. By sharing science in the classroom, you can help students...

- understand the positive and vital role of science, mathematics, and technology in today's world,
- gain an understanding of the work scientists do,
- see scientists as real people,
- lay the foundation for careers in science and technology, and
- grow in their enjoyment of the world around them.

Just a few hours of your time can make a big difference. Teachers are eager to invite you into their classrooms and to help you work with their students. This guide provides suggestions to smooth your transition from lab to classroom.

You and your colleagues working in science and technology fields are doers . . . doers can teach — by example, by working to expand science education in all levels of the educational system, and by sharing with teachers and students in the classroom.

Now —

Get ready!

Get set!

Go!

GET READY!

Survival Tips for Your Classroom Visit

Before you go into the classroom...

- **Decide on your approach.**

You may select some aspect of the curriculum. An alternative, more personalized, approach is to focus on what you do.

- **Prepare your activity based on children's needs and abilities.**

Ask the teacher what students already know. "Typical Science and Technology Topics" on page 6 will give you a general understanding of what students typically learn at different grades. You can also check with the teacher about local curriculum and/or texts.

Know the age of the class you are visiting and their "Thinking and Learning Characteristics" (page 7).

- **Be prepared for student reactions and behavior.**

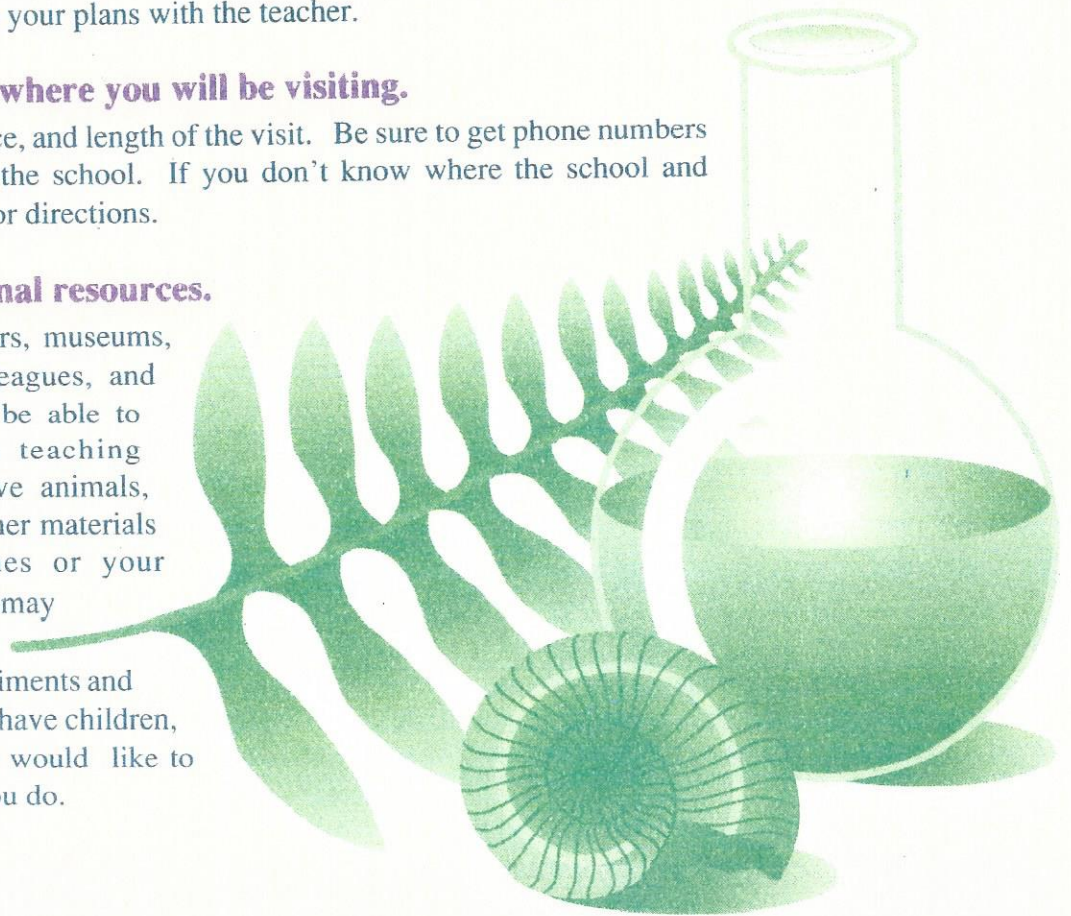
Keep in mind that teachers and parents may have concerns about how sensitive issues, such as evolution or reproduction, are presented to their children. If you have questions about appropriate ways to present your subject, discuss your plans with the teacher.

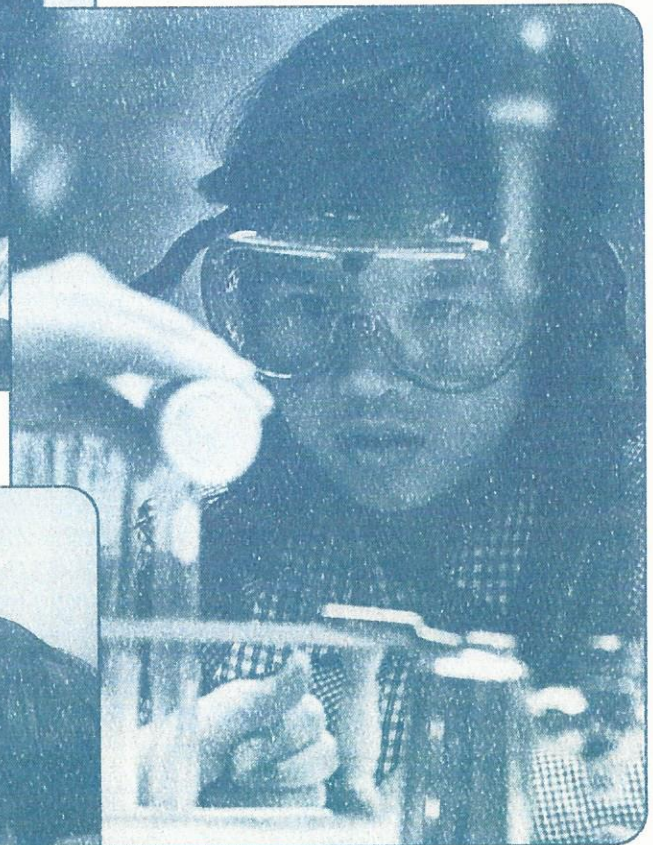
- **Know when and where you will be visiting.**

Verify the time, place, and length of the visit. Be sure to get phone numbers for the teacher and the school. If you don't know where the school and classroom are, ask for directions.

- **Look for additional resources.**

Local science centers, museums, libraries, your colleagues, and other sources may be able to provide hands-on teaching materials, films, live animals, activity kits, and other materials to use. Colleagues or your professional society may be able to give you good ideas for experiments and things to do. If you have children, ask them what they would like to know about what you do.





GET SET!

- **Assemble your notes and materials in advance.**

If each student is to have a handout or materials, make sure you have enough of each. See that materials are organized. Do a test run of experiments, games, or any other activities you plan to do.

- **Prepare to use terminology that is appropriate for the students.**

If there are a number of words or concepts students would benefit by knowing in advance, give them to the teacher and (s)he can help students learn them.

- **Allow yourself enough time to get to the school and to find the classroom.**

GO!

- **Share yourself.**

Let the children know you are a real person with a family, pets, hobbies. Talk about how you got to be a chemist, an anthropologist, an engineer, . . . Was there a special event or person in your life — a teacher, a learning experience, a book, a visit to a museum — that aroused your interest in your field? What do you do on an average day? What is interesting or unique about your work?

- **Involve the students in doing.**

Bring an attention grabber if you can. Keep in mind that your goal is to arouse curiosity, excitement, eagerness to know more. The tools of your profession may be commonplace to you, but they are mysterious, unknown, even fascinating to most of the students (and teachers) you meet. When possible, let students handle models, equipment, samples, plants, prisms, stethoscopes, rocks, or fossils.

- **Involve students in the process of science.**

Do a simple experiment in which the students participate. The process skills of science — observing, identifying, classifying, measuring — are the skills that enable students to apply science to everyday problems.

- **Stimulate thinking by asking questions.**

Questions that ask students to make a prediction, to give an explanation, to state an opinion, or to draw a conclusion are especially valuable. Be sure to allow time for each student to THINK before anyone gives answers.

- **Use language the students will understand.**

Be conscious of vocabulary. Try not to use a difficult word when a simple one will do. Define words students may not know. For example, don't say, "I am a cytologist" and begin a lecture on semipermeable cell walls. Rather, ask students if they know what a cell is and then tell them you study cells, how they are built, and how they act, and that you are called a cytologist.

- **Make what you are talking about real to the students.**

Show the students that the area of science or technology you work with every day is part of their everyday lives, too. How has what you and your colleagues have learned up to this time changed how we do things or understand things? How will what you do make the students' lives better or different in the future? How does what you do and know relate to what they are learning in school?

- **Prepare the students for the unexpected, if appropriate.**

Unexpected loud noises, bright lights, unusual odors, graphic photographs, and similar experiences that evoke strong emotion or fright can disturb some children. It may be wise to warn students that a surprise or something unusual is coming even when evoking a degree of surprise is one part of your goal.

- **Leave more than a memory behind you.**

Help set up an experiment that students can continue after you leave. Hand out an assignment — find out how many birds live in the local area, gather samples of leaves from local trees, make a cardboard glider — for the students to complete on their own or with their families. Invite them to write to you with questions — and plan on answering those letters quickly!

- **Ask for an evaluation of your efforts.**

Ask the students what they liked (and didn't like) about your visit. Ask the teacher to critique your presentation and help you improve your in-class skills.

- **Schedule your next visit!**

TEACHING TIPS

Make eye contact with the students because they love the personal contact.

Smile and feel comfortable telling amusing anecdotes because kids love a good laugh.

Organize all materials in advance because kids sometimes have a hard time waiting.

Use student volunteers to help you set up and distribute materials, samples, pictures, and handouts because kids love to feel important.

Require that students raise their hands to participate because they will probably all want to talk at once.

Call on many different members of the class because everyone wants to be involved.

Model good safety practices because kids learn by following role models.

Give specific directions when distributing specimens because kids sometimes disagree about who has been holding an object the longest.

Use a prearranged signal to get students' attention during activities (clapping, flipping light switch, etc.) because it is too hard to give good directions unless students are quiet.

Stop and wait for students to let you continue speaking if they get noisy because they have probably heard the "cold silence" before and know that it means they need to be less noisy.

Wait to give handouts to students until it is time to read or use them because if the students have the handouts while you are speaking they will be distracted.

Wait several seconds before calling on students to answer a question because the whole class needs time to think about the question before someone answers it.

Praise attentive or helpful behavior because this is the behavior you want to encourage.

Enjoy the students, their enthusiasm, and their sense of wonder because they have a fascinating perspective on the world!

Typical Science and Technology Topics

Kindergarten

First and Second

Third and Fourth

Fifth and Sixth

Animals



Many kinds
Have different coverings
Eat different kinds of foods

Are alike and different
Move and grow
Different homes
Different sounds
Care of pets

Adaptations to the environment
Defense mechanisms
Helpful and harmful animals

Animal classification
Selective breeding
Interaction with the environment
Balance of nature

Plants



Many kinds
Grow in different places
Vegetables and fruits

Characteristics of plants
Collecting parts of plants
Seeds become plants
Uses of plants

Classification of plants
Effect of soil, water, air, and light on growth
Conservation
Prehistoric plants

Parts and functions
Life processes
Plant movements
Adaptation

Weather



Days can be sunny, cloudy, rainy, and snowy
Four seasons

Air occupies space, has weight
Atmosphere
Air has pressure
Wind is moving air

Effect of sun on earth
Temperature and thermometers

Evaporation and condensation
Precipitation
Air masses
Forecasting and instruments
Factors affecting climate

Physical & Chemical Properties



Things have colors, sizes, shapes
Classifying objects
Hot and cold
Serial ordering

States of matter
Different types of matter
Dissolving
Movement of things in air, water
Sinking and floating

Expansion and contraction
Heat
Fuels
Producing sound
Music

Atoms
Chemicals
Mixtures and compounds
Matter and energy
Sources of energy
Reflection/refraction
Lenses

Electricity & Magnetism



Sources of electricity
Uses of electricity
Safety

Magnets
Simple compass
Uses of magnets

Static electricity
Nature of electricity
Simple circuit
Batteries
Series and parallel circuits
Safety

Earth & Space Science



Moon
Day and night
Water
Soil

Sun, moon, earth
Stars
Day and Night

Heat and light
Seasons
Day, night, year
Tides and eclipses
Solar system
Gravity, inertia and orbit
Comets, meteors and meteorites
Space exploration

Ecology
Pollution
Recycling
Constellations
Space travel
Flight
Oceans
Water cycle
Properties of water

Message to all members of the scientific and engineering communities concerned about improving science education in the nation's schools:

I encourage practicing scientists and engineers to share personally some of their knowledge and experience with school children.

In September of 1989, President Bush convened the historic Education Summit with the Nation's Governors in Charlottesville, Virginia. The National Education goals developed following the Summit established targets for American educational achievement by the year 2000. The National Science Foundation and other Federal agencies, in partnership with the States, school districts, academic institutions, private industry and professional organizations, are generating the systemic reforms needed to realize these national goals as they apply to mathematics and science achievement for all students. Yet these reforms, which include improved curricula and better teacher preparation, cannot in themselves convey fully the excitement and dynamics of modern science. There is no substitute for personally meeting real scientists and engineers in the classroom and learning first-hand about what they do.



Many of you may have little formal teaching experience. Others who are teachers may never have taught at the grade school level. Some may question their ability to convey their knowledge and experience adequately to school age children. Yet each of you has a unique and important story to tell. This pamphlet provides reliable, time-tested guidance as to what to expect when you enter the classroom, how to support and complement the school curriculum, and how to make your visit a valuable, enriching experience for the students. You will find that it can be a deeply rewarding personal experience for you as well.

I urge each of you to contribute in this unique way to the enrichment of mathematics and science education in our schools. By doing so, you can help today's students to lead fuller and more productive lives in the future. You might also help to inspire and motivate the students who will become the next generation of professional scientists and engineers.

Luther S. Williams

Assistant Director for Education and Human Resources
National Science Foundation

Thinking and Learning Characteristics of Young People

Early Elementary (K-2)

As a thinker . . .

- Learns through manipulating objects.
- Believes what he or she sees.
- Can't trace steps back from a conclusion.
- Sees parts, not the whole.
- Does not understand that making physical changes in an object does not change its amount.

As a learner . . .

- Is expansive, adventurous, curious, eager to learn, energetic, always in motion, loud, and emotional — has mood swings.
- Wants to please adults.
- Has difficulty controlling impulses and regulating behavior.
- Is very "me" centered. Seeks attention. Loves praise.
- Likes to work in groups, but will need assistance.
- Can sit still and listen 10-15 minutes; needs frequent change of pace.

Late Elementary (3-5)

As a thinker . . .

- Although still somewhat tied to seeing in order to believe, begins to understand concepts as well as objects.
- Understands hierarchical classification systems.
- Can combine, sort, multiply, substitute, divide.
- Begins to generalize, formulate hypotheses, use systematic problem-solving strategies.
- Likes to memorize, to learn facts.

As a learner . . .

- Understands rules and can follow them.
- Likes group activities and excursions. Is a great socializer and eager to fit in.
- Considers fairness to be important.
- Takes initiative and is self motivated.
- Is becoming an independent learner.
- Is a perfectionist who will practice the same thing over and over again.
- Avoids opposite sex.
- Can sit still and listen 20-30 minutes (variety increases attention span).

Middle Grades (6-8)

As a thinker . . .

- Can hypothesize, create propositions, and evaluate.
- Can conceptualize in the abstract and understand probability.
- Begins to understand multiple causation.
- Developing understanding of ethical principles.

As a learner . . .

- Is emotional, restive, and eager to get moving.
- Is easily bored.
- Challenges rules, routines, and authority.
- Is beginning to have an interest in the opposite sex.
- Is typically more oriented to small group activity.
- Has a vulnerable ego, is very self-conscious and concerned about how he/she is perceived by others.
- Can handle 30-40 minute sessions.

COMMIT TO THE CHALLENGE

Learn about and support science related activities in your local community and those sponsored by state and national organizations. Here are some resources:

Each year the **National Science Foundation** (NSF) designates the last full week in April as National Science & Technology Week. NSF provides instructional kits with student activities, educational posters, and other materials. It encourages teachers, scientists, and others to participate through school activities, community projects, and public lectures. National Science & Technology Week will be celebrated in 1992 on April 26-May 2.

The **Association of Science-Technology Centers** and its member science museums promote experiences in science and technology for children, families, and the general public. Science centers and museums feature hands-on exhibits, science activities, and teacher training workshops and serve as educational resources to their communities. Contact your local science center to offer your support. ASTC can refer you to museum contacts in your state. Call (202) 783-7200 for assistance.

The **American Association for the Advancement of Science** (AAAS) sponsors activities through its Committee on the Public Understanding of Science and Technology including a project which encourages scientists to volunteer at science and technology centers and other places of science. Call (202) 326-6602.

Many professional societies lend support to local schools, museums, and other community institutions. Check with your national organization to find out what programs or materials are available.

Developed by the North Carolina Museum of Life and Science based on numerous publications, guidelines, and other sources drawn from all over the United States. Non-commercial duplication is encouraged. We want to know how you use this guide and any suggestions you have for improving it. Contact: Georgiana M. Searles, Director of Education, North Carolina Museum of Life and Science, P.O. Box 15190, Durham, North Carolina 27704.

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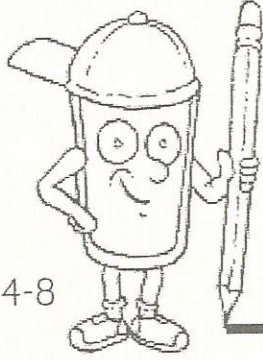
North Carolina
Museum of Life and Science

SHARING SCIENCE WITH CHILDREN:

A Survival Guide for Scientists and Engineers



Printed on recycled paper



4-8

Water Filtration

BACKGROUND:

Water in lakes, rivers, and swamps often contains impurities that make it look and smell bad. The water may also contain bacteria and other microbiological organisms that can cause disease. Consequently, water from most surface sources must be "cleaned" before it can be consumed by people. Water treatment plants typically clean water by taking it through the following processes: (1) **aeration**; (2) **coagulation**; (3) **sedimentation**; (4) **filtration**; and (5) **disinfection**. Demonstration projects for the first four processes are included below.

OBJECTIVE:

To demonstrate the procedures that municipal water plants may use to purify water for drinking.

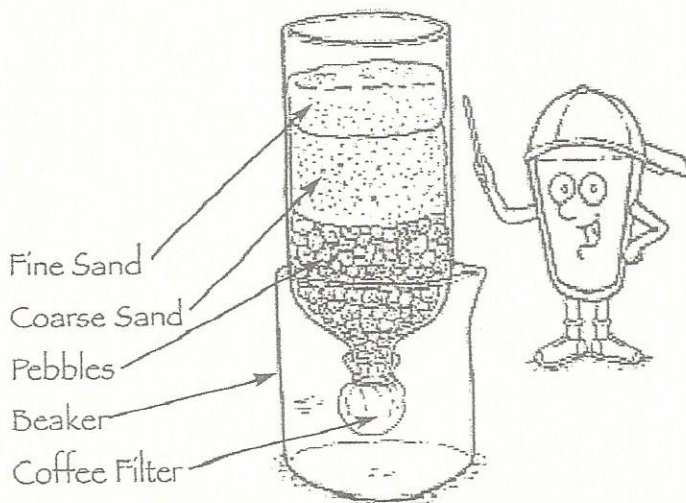
MATERIALS NEEDED:

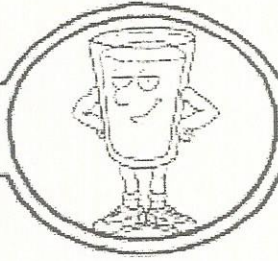
- ✓ 5 Liters of "swamp water" (or add 2 1/2 cups of dirt or mud to 5 liters of water)
- ✓ 1 Two liter plastic soft drink bottle with its cap (or cork that fits tightly into the neck)
- ✓ 2 Two liter plastic soft drink bottles, one with its bottom cut off and one with the top cut off
- ✓ 1 large beaker (2 cups) or measuring bowl that will hold the inverted two liter bottle or you can use another two liter plastic soft drink bottle with its top cut off so the other bottle will fit inside of it.
- ✓ 2 tablespoons of alum (potassium aluminum sulfate available in the spice aisle at grocery stores)
- ✓ 1 1/2 cups fine sand (white play sand or beach sand)
- ✓ 1 1/2 cups coarse sand (multi-purpose sand)
- ✓ 1 cup small pebbles (washed, natural color aquarium rocks work best)
- ✓ 1 coffee filter
- ✓ 1 rubber band
- ✓ 1 tablespoon (for the alum)
- ✓ 1 large spoon (for stirring)
- ✓ A clock with a second hand or a stopwatch

PROCEDURE:

1. Pour your "Swamp Water" into the two liter bottle with a cap. Have students describe the appearance and smell of the water.
2. **Aeration** the first step in the treatment process, adds air to water. It allows gases trapped in the water to escape and adds oxygen to the water. Place the cap on the bottle and vigorously shake the bottle for 30 seconds. Continue the aeration process by pouring the water into another bottle or the beaker, then pouring the water back and forth between them about 10 times. Once aerated, gases have escaped (bubbles should be gone). Pour your aerated water into your bottle with its top cut off.
3. **Coagulation** is the process by which dirt and other suspended solid particles to chemically "stick together" into floc (clumps of alum and sediment) so they can easily be removed from water. Add two tablespoons of alum to the aerated water. Slowly stir the mixture for 5 minutes. You will see particles in the water clinging together to make larger clumps. This makes it harder for them to get through a filter at the plant.
4. **Sedimentation** is the process that occurs when gravity pulls the particles of floc to the bottom of the cylinder. Allow the water to stand undisturbed in the cylinder. Observe the water at 5 minute intervals for a total of 20 minutes. Write down what you see - what is the appearance of the water now? At a treatment plant, there are settling beds that collect floc that floats to the bottom, allowing the clear water to be drained from the top of the bed and continue through the process.
5. Construct a filter from the bottle with its bottom cut off as follows (see illustration below):
 - a. Attach the coffee filter to the outside neck of the bottle with a rubber band.
Turn the bottle upside down placing it in a beaker or cut-off bottom of a two liter bottle. Pour a layer of pebbles into the bottle - the filter will prevent the pebbles from falling out of the neck.
 - b. Pour the coarse sand on top of the pebbles.
 - c. Pour the fine sand on top of the coarse sand.
 - d. Clean the filter by slowly and carefully pouring through 3 L (or more) of clean tap water.
Try not to disturb the top layer of sand as you pour the water.
6. **Filtration** through a sand and pebble filter removes most of the impurities remaining in water after coagulation and sedimentation have taken place. After a large amount of sediment have settled on the bottom of the bottle of swamp water, carefully - without disturbing the sediment - pour the top two-thirds of the swamp water through the filter. Collect the filtered water in the beaker. Pour the remaining (one-third bottle) of swamp water back into the collection container. Compare the treated and untreated water. Ask students whether treatment has changed the appearance and smell of the water.

Advise students that the final step at the treatment plant is to add disinfectants to the water to purify it and kill any organisms that may be harmful. Because the disinfectants are caustic and must be handled carefully, it is not presented in this experiment. The water that was just filtered is therefore unfit to drink and can cause adverse effects. It is not safe to drink!





Decision Making

A Mock Town Meeting On A Proposed Tank Farm

INTRODUCTION:

Your class will represent all of the citizens who live and work in a small town called Priceford. A major business development company called Zanec Corporation has asked Priceford for permission to install five 10,000 gallon Underground Storage Tanks (USTs) on their property just outside of Priceford.

This proposed tank farm will supply fuel and manufacturing chemicals to an existing Ball Bearing Factory. Your class will divide into several groups each having very different interests, and will hold a town meeting to discuss and vote on Zanec's proposal.

OBJECTIVE:

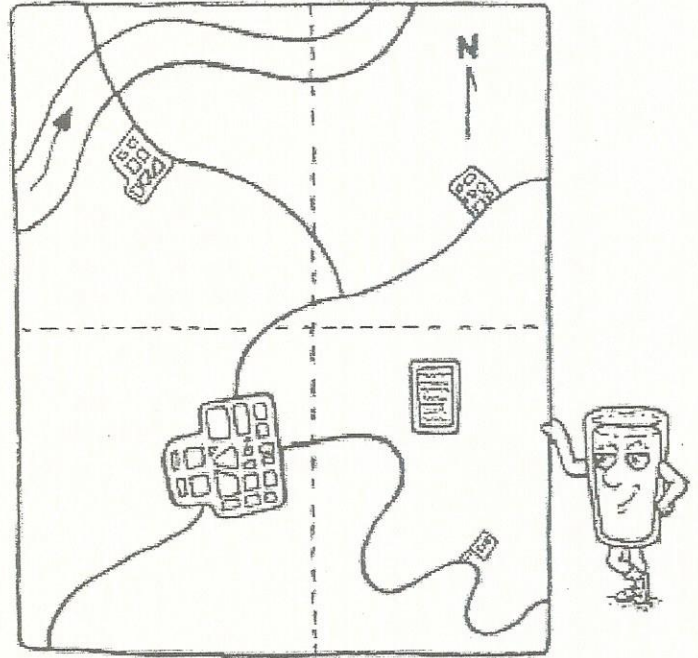
Your class will gain experience in recognizing potential hazards to a community's water supply and weighing the risks and benefits of community development, and will practice decision-making skills in a mock town meeting.

GENERAL PROCEDURES:

1. After reading over the activity's introduction and objectives as a class, begin preparing for the town meeting by randomly dividing your class into five groups.
2. Once the groups are formed, they should take (at home or in class) the time they need to:
 - a. Study the facts of Priceford's water resources
 - b. Elaborate on their own special group's interests.
 - c. Discuss how each item of Zanec's proposal affects their interests.

The background information each group will need for these three tasks is given below. Each group should also select its own spokesperson to represent the group's interests at the meeting.

3. When each group is ready, the Town Council should call the town meeting to order, read the Agenda and introduce the Zanec and Business group to present their proposal. Each other group should then be allowed to comment on the proposal.
4. The Council will summarize the issues it believes to be important, BRIEFLY support or refute each issue and then vote on the proposal.



Priceford's Water Resources:

Priceford gets more than half its water from municipal and private wells. The vulnerability of the underlying aquifer in each quadrant of the map below was assessed in the Resource Management Activity (use the vulnerability "scores" calculated for the four quadrants in this activity).

- Quadrant 1 is largely undeveloped in the Priceford area. A small community, Riverville, is about 25 miles down the river. This quadrant is least acceptable to Zanec due to its distance from its property in Quadrant 4.
- Quadrant 2 is largely farmland but also contains a small community which relies on well water.
- Quadrant 3 includes Priceford town center and all the residential areas for the town's citizens.
- Quadrant 4 contains a factory just north of Bucky's Corner. Zanec proposes installing the USTs here.

Special Group Interests

1. THE TOWN COUNCIL - you must conduct the meeting, listen to all the arguments, and decide what is best for all citizens. Based on the facts you gather, the most logical arguments made by any of the groups and your best judgment, you will vote on whether to:

- 1) Allow Zanec to install the tank farm as proposed, OR
- 2) Allow installation only with certain changes in the proposal, OR
- 3) Reject the proposal completely

2. ZANEC and the local BUSINESS GROUP - You must stress the need to allow the Ball Bearing plant to expand and to attract new businesses for Priceford's economic well-being.

3. LOCAL HOME OWNERS - You are divided. Some desire the new jobs and prosperity made possible by developments like this; others worry about the potential for water, air and noise pollution; still others are concerned about property values; and others are concerned about taxes needed to meet the increased solid waste disposal and sewage demands which are related to development.

4. SAVE THE ENVIRONMENT - Your local chapter of this national group opposes the installation of any USTs until extensive testing has been done and sufficient safeguards are in place. You favor the least vulnerable (but least accessible) site.

5. THE COUNTY HEALTH DEPARTMENT - You are essentially neutral as long as the proposed installation complies with all county health laws and procedures. You must find out whether the proposal meets these standards.

Zanec's Proposal:

Zanec is a major development company which has already invested heavily in the Priceford area. The proposed tank farm is only one improvement in its existing developments. Zanec believes its proposal is in the interest of Priceford for the following reasons:

- The tank farm will allow the Ball Bearing plant to expand, bringing about 250 new jobs to an area that has an unemployment rate which is above the state average.
- The company will bring revenues to Priceford, not only through wages, but also through property taxes, income taxes and more consumer spending by its workers and their families.
- The Ball Bearing plant expansion will be attractively designed, well-maintained and an asset to the community.

- The UST Installation will comply with all current regulations and is critical to whether Zanec can continue to build in Priceford.
- The new jobs will result in new home building and increased property values.
- Taxes paid by the plant will help finance school and road improvements while helping to keep home owner's taxes low.
- Zanec requests permission to site its tank farm on its property in Quadrant 4 (see map)

Town Meeting Agenda

This notice was published in the Priceford newspaper.

TO ALL CONCERNED PARTIES

An open meeting will be held for community review and input on Zanec Corporation's proposed installation of five 10,000 gallon underground storage tanks on property to the Ball Bearing factory. All interested groups are to have selected spokespersons who will each be given 4 minutes to present their views. The public is invited to comment on the following issues:

1. Should Zanec be allowed to install the USTs at the proposed site?
2. If not, what alternative location is acceptable to all parties?
3. What are the risks related to the proposal?
4. How can the risks be minimized to protect ground water?

The remainder of the meeting will consist of a question and answer period after which the Council will vote on the proposal.

Location: Priceford Town Hall
Time: Friday Afternoon

The town meeting Agenda should serve as a guide for the Town Council to conduct the meeting. As stated in the notice the Council should allow each group only 4 minutes to offer their views on each of the questions on the Agenda.

When all groups have been heard, each Town Council member may ask one question of one group. Finally, the Council will vote on the proposal. The Council's vote should be based to a large degree on the most logical and persuasive arguments raised by the groups.



Aeration Adds oxygen to water, removes trapped gasses.

Pre-chlorination Destroys pathogenic bacteria.

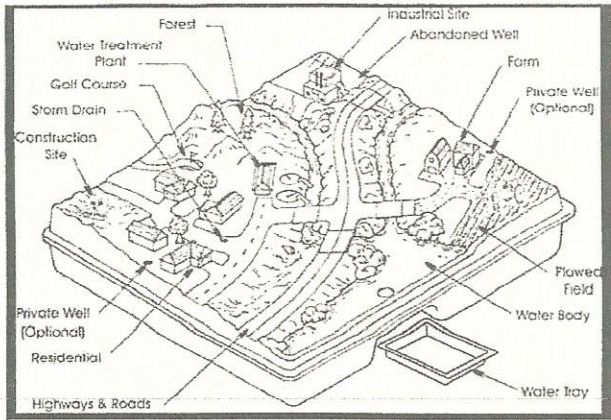
Coagulation Removes suspended solids by adding alum to water.

Sedimentation Allows the floc (coagulated particles) to settle out.

Sand Filtration Removes finer suspended particles.

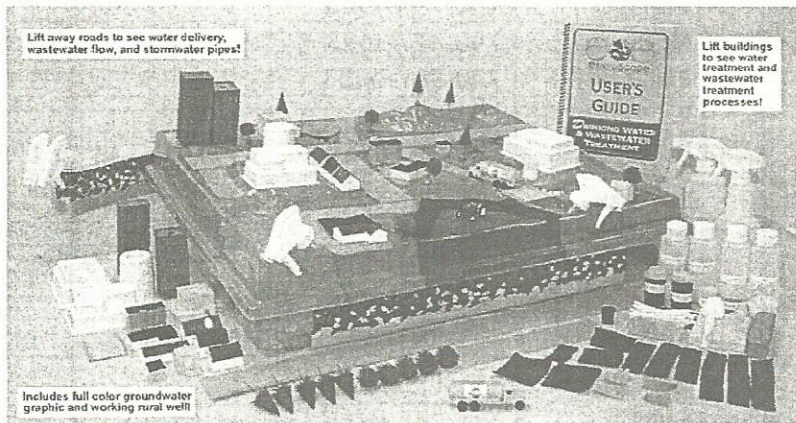
Post Chlorination Ensures that bacteria will not infect the water as it travels through the distribution system to the consumer. (Ozone and ultraviolet radiation also used in place of chlorine.)

Models available from many Ohio Soil and Water Conservation Districts



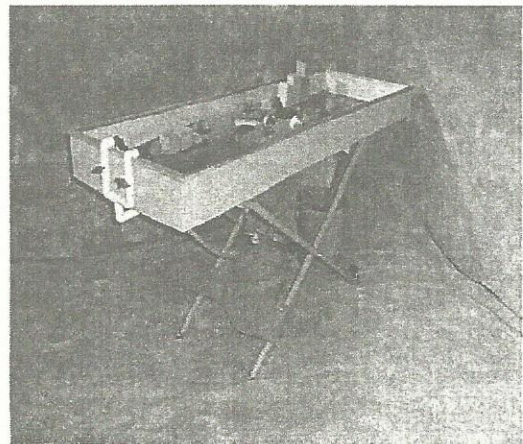
EnviroScape Watershed and Nonpoint Source Pollution Model (card table size)

Ground Water Flow Model



Drinking Water and Wastewater Treatment Model

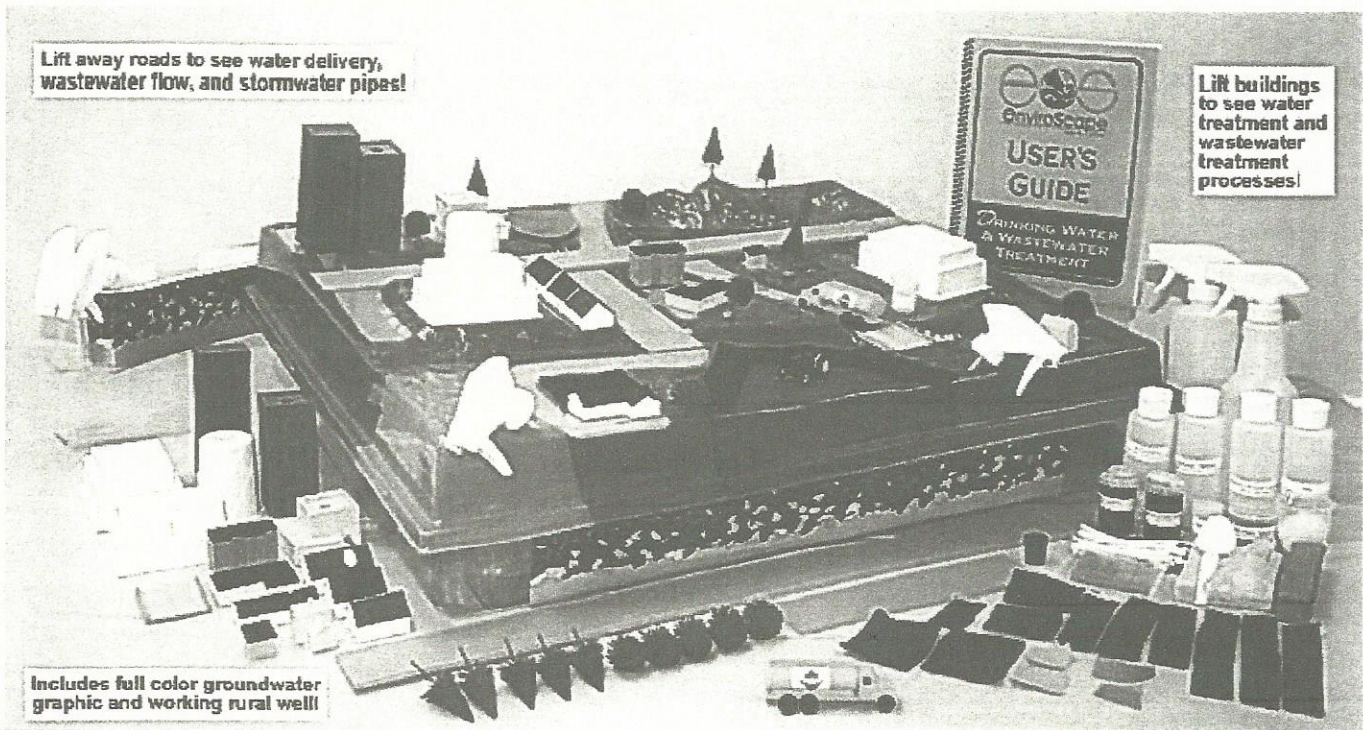
Streamulator Stream Table



EnviroScape Watershed (ES), Ground Water Flow (GW), Drinking Water (DW), and Stream Table (ST)
 Models available from Ohio's Soil and Water Conservation Districts

SWCD	Phone #	ES	GW	DW	ST	SWCD	Phone #	ES	GW	DW	ST
Adams	937-798-4018		*	*	*	Licking	740-670-5330		*	*	
Allen	419-223-0040	*				Logan	937-593-2946	*	*	*	*
Ashland	419-281-7645	*	*		*	Lorain	440-326-5800		*		*
Ashtabula	440-576-4946	*	*		*	Lucas	419-893-1966	*	*	*	*
Athens	740-797-9686	*	*	*	*	Madison	740-852-4004	*	*	*	*
Auglaize	419-738-4016	*	*			Mahoning	330-740-7995	*	*	*	
Belmont	740-526-0027	*	*	*		Marion	740-387-1314	*	*		
Brown	937-378-4424	*	*	*		Medina	330-722-2628	*	*	*	*
Butler	513-887-3720	*	*	*		Meigs	740-992-4282	*	*	*	
Carroll	330-627-9852	*	*	*	*	Mercer	419-586-3289		*	*	
Champaign	937-484-1507	*	*	*	*	Miami	937-335-7645	*	*	*	
Clark	937-521-3880	*	*			Monroe	740-472-5477	*	*		
Clermont	513-732-7075	*	*		*	Montgomery	937-854-7645	*	*		*
Clinton	937-382-2461	*				Morgan	740-962-4234	*	*		
Columbiana	330-332-8732	*	*	*		Morrow	419-946-7923	*	*		*
Coshocton	740-622-8087		*	*		Muskingum	740-454-2027		*	*	*
Crawford	419-562-8280		*			Noble	740-732-4318	*	*	*	*
Cuyahoga	216-524-6580	*	*	*	*	Ottawa	419-898-1595	*	*	*	
Darke	937-548-2410	*	*			Paulding	419-399-4771	*	*		
Defiance	419-782-8751	*	*	*	*	Perry	740-743-1325	*	*	*	*
Delaware	740-368-1921	*	*	*	*	Pickaway	740-477-1693	*	*	*	*
Erie	419-626-5211	*	*	*		Pike	740-947-5353	*			*
Fairfield	740-653-8154	*	*	*		Portage	330-297-7633	*	*	*	
Fayette	740-636-0279	*	*			Preble	937-456-5159		*		*
Franklin	614-486-9613	*	*	*	*	Putnam	419-523-5159	*	*		
Fulton	419-337-9217	*	*		*	Richland	419-747-8686	*	*		
Gallia	740-446-6173	*	*	*	*	Ross	740-772-4110	*			*
Geauga	440-834-1122	*	*		*	Sandusky	419-334-6324	*			
Greene	937-372-4478	*	*	*	*	Scioto	740-259-9231	*	*	*	
Guernsey	740-432-5624	*	*	*		Seneca	419-447-7073		*		
Hamilton	513-772-7645	*	*		*	Shelby	937-492-6520	*	*	*	*
Hancock	419-422-6569	*			*	Stark	330-830-7700	*	*		
Hardin	419-673-0456	*				Summit	330-929-2871		*	*	*
Harrison	740-942-8837	*	*	*		Trumbull	330-637-2056	*	*	*	*
Henry	419-592-2926	*	*			Tuscarawas	330-339-7976	*	*	*	*
Highland	937-393-1922	*	*	*		Union	937-642-5871	*	*		*
Hocking	740-385-3016		*	*	*	Van Wert	419-238-9591	*	*	*	
Holmes	330-674-2811	*	*			Vinton	740-596-5676	*			
Huron	419-668-4113	*	*		*	Warren	513-695-1337	*	*		
Jackson	740-286-5208	*	*		*	Washington	740-373-4857	*	*	*	*
Jefferson	740-264-9790	*	*	*		Wayne	330-262-2836	*	*		*
Knox	740-393-6724	*	*	*	*	Williams	419-636-9395	*	*	*	
Lake	440-350-2730	*	*	*	*	Wood	419-354-5517	*	*	*	*
Lawrence	740-867-4737	*	*	*	*	Wyandot	419-294-2312	*	*	*	

Enviroscape Drinking Water and Wastewater Treatment Model



Some SWEETs are using the EnviroScape Drinking Water and Wastewater Treatment Model (the fact sheet indicates which team has this model). The model can show:

- **Drinking Water Sources and Treatment** - shows where drinking water (residential and commercial, rural and urban) comes from and how it is delivered to us;
- **Wastewater Treatment** - shows what happens to water and waste after we use it (how sewage/wastewater is treated)
- What **biosolids** are and how they are being used or disposed.
- How drinking water can become **contaminated**.

Students can trace the path of water we use in our communities:

- from the river to the water treatment plant
- from the treatment plant to houses and city buildings
- from use in the houses and city to the wastewater treatment plant, and
- from wastewater treatment back into the river

The model also includes:

- Septic system and rural water sources
- Stormwater discharged directly to a waterbody OR sent on to the wastewater treatment plant; and

- [Demonstration of a combined sewer overflow](#)
 - [Groundwater & much more!](#)
-

RESOURCES FOR USING THE ENVIROSCAPE

- [Enviroscape Web Page](#)
- [Enviroscape Manual](#)
- [Enviroscape Simplified Guide](#)
- [Users Tips](#)
- [Replacement Parts List](#)
- [Find out where the Drinking Water Comes from in the Community you are visiting](#) - Many schools and communities get their water from a public water system. Almost all of the Public Water Systems in Ohio have had a Drinking Water Source Assessment completed as required by the [Source Water Assessment and Protection \(SWAP\) program](#). These reports contain information on the source of their drinking water (ground water or surface water), and are available online via a secure web site. A [registration form](#) is available if you are not registered.

Water Treatment Plants

- [USGS Posters](#)
- [Drinking Water Basics](#)
- [Public Drinking Water Standards for Ohio](#)
- [AWWA Poster: Drinking Water Treatment Plants](#)

Wastewater Treatment Plants

- [Wastewater Treatment Interactive Guide](#)
- [USGS: A Visit to a Wastewater Treatment Plant](#)
- [OSU Extension Fact Sheet: Wastewater Treatment Principles and Regulations](#)
- [Wikipedia: Sewage Treatment](#)
- [USGS Posters](#)
- [AWWA Poster: Wastewater Treatment Process](#)

Combined Sewer Overflows

- [Combined Sewer Overflows In Ohio](#)
- [USEPA: Combined Sewer Overflows](#)

Septic Systems

- [How do Septic Systems Work?](#)
- [Why do Septic Systems Malfunction?](#)
- [USEPA Fact Sheet: A Homeowner's Guide to Septic Systems](#)
- [Septic Systems and their Maintenance](#)
- [Household Sewage Disposal Systems - Ohio Rules](#)

Biosolids

- [Frequently Asked Questions about Biosolids](#)
- [Ohio EPA Biosolids Program](#)
- [Fields in Ohio Approved for Biosolids Applications](#) (GIS interactive map)



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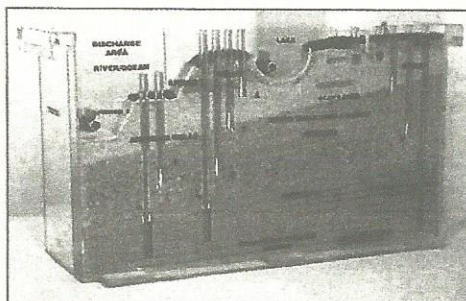
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Manufacturer of Environmental Education Products and Groundwater Flow Models



click on photo for additional images

Envision 3000 Model

--Sand/Gravel and Bedrock/Karst Aquifers

Envision 3000 -Bedrock/Karst Aquifer Model

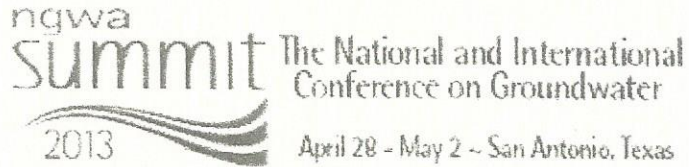
This simulator shows all the key features of the Envision 2000 with the added features of a bedrock aquifer. It shows groundwater flow and contamination in both unconfined and confined sand and gravel aquifers overlying cavernous limestone and fractured-bedrock aquifers. Presenters can easily compare and contrast the different flow patterns between the various types of aquifers. This simulator is particularly useful in areas where the local geology contains caves, sinkholes, fractured non-porous bedrock or has been extensively deep-mined.

Model is 19.5 long x 12 in high x 8 in deep.

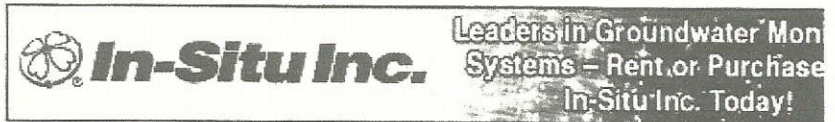
- 9 wells (including 2 artesian wells)
- 2 springs
- Lake
- Stream/Ocean
- Septic System
- Sand & Gravel Aquifers
- Confined Bedrock Aquifer
- Cavernous Limestone/Karst Aquifer
- Fractured Bedrock Aquifer
- Unconfined Aquifer
- Underground Storage Tank
- Recharge & Discharge Areas
- Recirculating Reservoir and Tank system
- Top display showing watershed/surface activities
- AC/DC power supply
- Manual pumping mechanisms simulating high and low volume well pumps

Detailed instruction manual with experiments

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[NGWA observation well](#)

[Reference sites and links](#)

[State information](#)

[Tools for studying groundwater](#)

[Virtual Museum of Groundwater History](#)

Educator resources

The National Ground Water Association has developed this list of groundwater re materials to help elementary and secondary education professionals prepare less subject of groundwater,. These materials may also be useful to anyone interester themselves and others about groundwater.

Please note that external Web sites and documents provided here are not endorse are provided for information purposes only.

Attention teachers: Please give us your feedback on our educator resources. We want to make them as useful as possible to you.

Sign up in the [Educator Resources Guest Book](#) and receive a free hydrologic cyc poster (18 x 24 inches) while supplies last. (Free only to teachers in the continen United States.)

Ground Water Flow Model Presentation

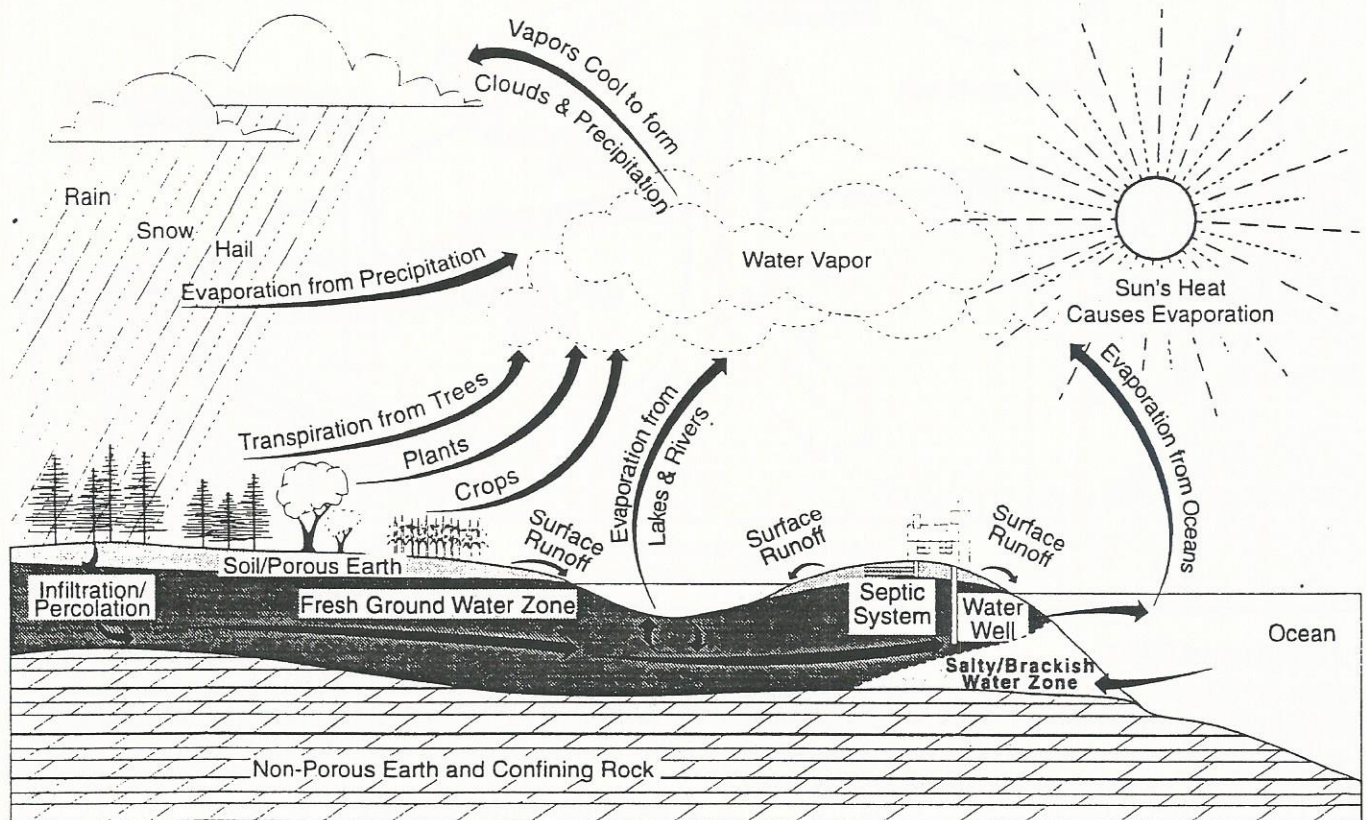
1. Introduce ground water as a very important resource to citizens in the state of Ohio. It is often considered a mystery because we can't see it in the ground, but it is really all part of the **water cycle**. Depending on grade level, have students act out or illustrate the water cycle, share what they know about the water cycle within a small group, or give a presentation on the water cycle to the class.
2. Share information on Ohio's **hydrologic budget**, including average amount of rainfall, amount lost to runoff, and amount that becomes ground water.
3. Show model, point out special features, and define terms or have students research **definitions** of confined and unconfined aquifer, water table, saturated zone, recharge and discharge areas, piezometer, pumping, injection, and artesian wells.
4. Depending on the grade level, introduce the following concepts and facilitate discussion with the students:
 - a. Ground water is usually recharged by precipitation and snowmelt.
 - b. It is contained in spaces between soil particles or cracks in rocks.
 - c. It flows from upland areas to low areas or from areas of high hydraulic head to areas of low hydraulic head.
 - d. It is withdrawn from the ground through wells for use in homes, farms, and industries.
 - e. It is related to surface water and other forms of water through water cycle.
 - f. Differences in types of aquifers and the separating layers.
 - g. Saturated and unsaturated zones, water table, and monitoring wells.
 - h. Water movement in artesian aquifers.
 - i. Potentiometric surface in a well penetrating a confined aquifer.
 - j. Texture of materials in an aquifer affects the rate of ground water flow.
 - k. Pumping wells draw water toward them from all directions (cone of depression).
 - l. Human activities at or near the land surface can contaminate ground water and wells.
 - m. Contaminated ground water may pollute surface water, and vice versa.
 - n. Capillary action can cause upward movement of water.
 - o. Once ground water becomes contaminated, the contamination may persist for long periods and extend over long distances.
 - p. Ground water flow lines have curved paths.
5. As you begin cleaning up the model, discuss the difficulty of cleaning up contaminated ground water resources.



Ohio Department of Natural Resources Division of Water Fact Sheet

Fact Sheet 93-18

The Hydrologic Cycle



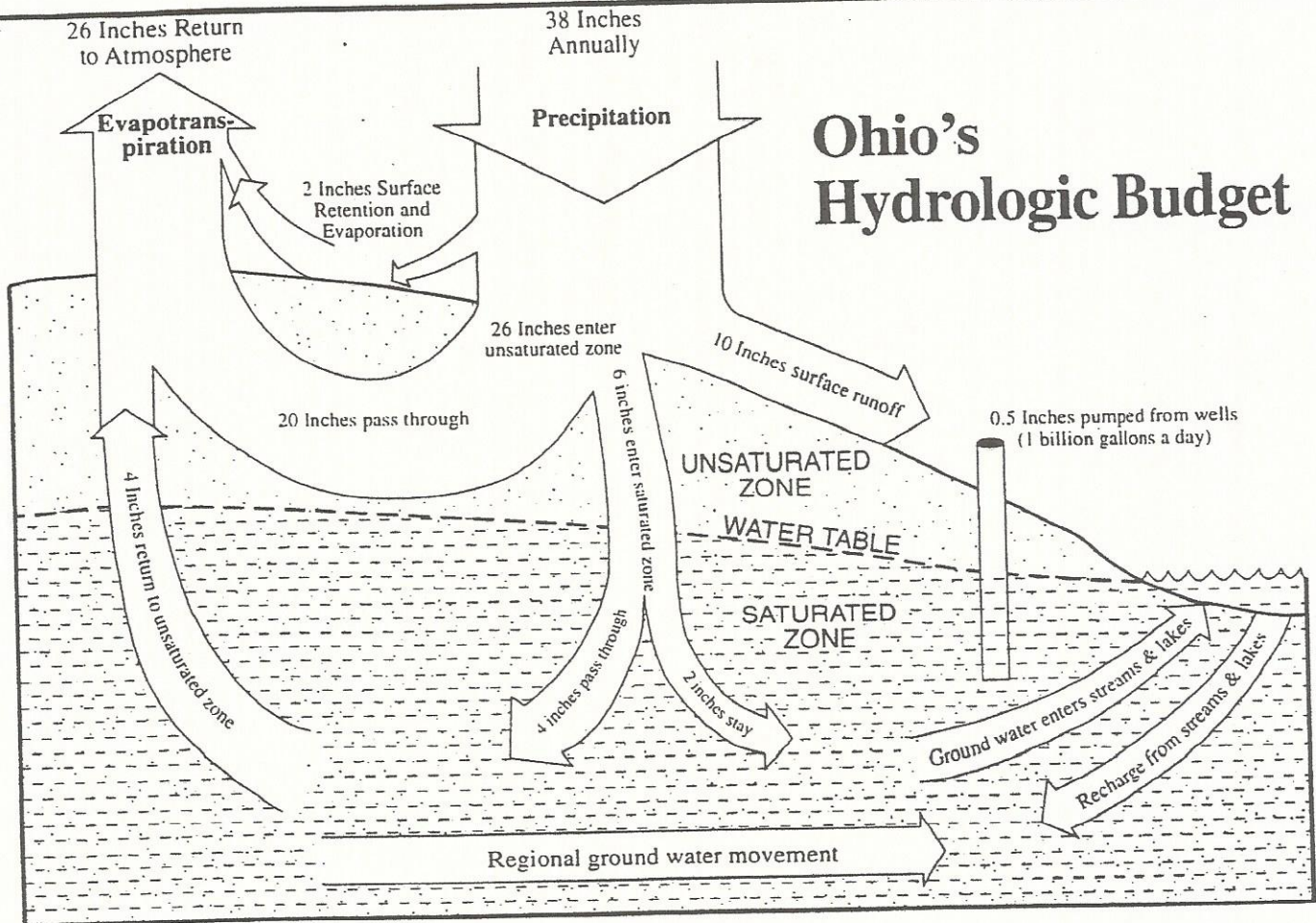
Water, our most precious resource. Over the millennia, great civilizations have both flourished and perished due to the availability of water. Today, industrialized societies are still, and possibly more so, dependant on reliable water supplies. In Ohio, each person uses about 75 gallons of water per day for household and other domestic uses. When the water that is used by industry and manufacturing, agriculture and households is added together, an average of over 11.7 billion gallons of water are used daily in Ohio, nearly 1,100 gallons per person. Even with more efficient use and other conservation efforts, as the population increases, so does the need for water.

A Renewable Resource

The amount of water on Earth has essentially never changed. It is continuously being recycled, moving from one storage place to another, including lakes, streams and oceans, underground, in glaciers and ice caps, and in the atmosphere. This recycling movement is called the water or hydrologic cycle. The hydrologic cycle (above) ex-

plains the exchange of water between the atmosphere, ground and surface of the Earth. The hydrologic cycle is perhaps the most important natural phenomenon on Earth; it is the driving force behind most other natural processes. The movement of water through the cycle annually replenishes our water supplies, thus making water a renewable resource. This replenishment takes place throughout the year, but is more pronounced during the winter and spring months.

The hydrologic cycle is an ever fluctuating, dynamic system. Small changes often occur in the quantities of water located in the various segments of the cycle. Many of these fluctuations relate to seasonal changes. For example, the amount of rainfall, the effect of temperature on evaporation, and the uptake of water by plants during the growing season all affect how much water will be available in any segment of the water cycle. Thus, the movement of water in the cycle is always changing. Even small changes in the cycle at a regional or local scale may look like large changes to us as in the form of droughts or floods.



What Happens in Ohio?

The water cycle is not unique to Ohio, rather the process occurs worldwide. A water budget is used to understand its effect on local water resources and to predict or estimate quantities of available water from surface or ground water sources.

The water budget for Ohio is illustrated above. Ohio averages about 38 inches of precipitation a year. Of this, 10 inches run off the land surface directly to streams and rivers, two inches are temporarily retained on the surface in puddles, etc. and then evaporate, and 26 inches enter or infiltrate into the ground. Of this latter 26 inches, 20 inches pass directly through the unsaturated zone (soil) and are returned to the atmosphere by evaporation from the soil and by plants through transpiration. The other six inches infiltrate into the saturated zone (aquifer). Of these six inches, four inches pass through the saturated zone and are returned to the atmosphere through evaporation and transpiration. The remaining two inches become part of the ground water system, eventually discharging to streams,

lakes and springs or are pumped to the surface by wells. Evaporation from lakes and streams (and oceans) returns the surface runoff and ground water discharge to the atmosphere, thus completing and balancing the cycle.

A Reliable Water Supply

The hydrologic cycle assures a reliable, although fluctuating, water supply by annually replenishing, or recharging, both surface and ground water sources. When water removal (evaporation, transpiration, water supply, etc.) exceeds replenishment (precipitation), water levels fall as usually observed during the summer and fall months; conversely, water levels rise when replenishment exceeds removal, usually during the winter and spring months. Properly designed wells and reservoirs with adequate storage for dry periods can provide a reliable water source for drinking, industry and agriculture thanks to the hydrologic cycle.

Ohio Department of Natural Resources
Division of Water

Water Resources Section

1939 Fountain Square

Columbus, OH 43224-1336

Voice: (614) 265-6740 Fax: (614) 265-6767

E-mail: water@dnr.state.oh.us

Web site: <http://www.dnr.state.oh.us/odnr/water/>



Bob Taft Governor • Samuel W. Speck Director • James R. Morris, P.E. Chief



Ohio Department of Natural Resources Division of Water Fact Sheet

Fact Sheet 93-24

What's Ground Water?

According to the dictionary, "ground water" is water saturating the voids, pores, fractures, and holes in the soil and rock at some depth below the earth's surface. While this definition is technically correct, it does not even begin to explain all the complex and varied aspects of ground water, or the importance of ground water to the nation and Ohio.

How Does It Occur?

There has always been some mystery connected with ground water because its source is unseen. Stories of underground lakes and rivers in Ohio are common, despite evidence disproving the existence of such bodies of water. In reality, the ultimate source of all ground water is precipitation. Part of the rain and snow that falls on the earth's surface seeps downward through the soil and collects in porous geologic formations. These formations act something like sponges and temporarily store the water. If these geologic formations are capable of yielding usable quantities of ground water to a well, they are called "aquifers."

There are two basic types of aquifers in Ohio, sand and gravel aquifers and bedrock aquifers. Ground water in sand and gravel aquifers occurs in pore spaces between individual grains of sand and gravel. In bedrock aquifers, ground water occurs in pore spaces and along fractures, joints, voids, and contacts between different formations.

The Hydrologic Cycle

Ground water flow is an important component of the natural circulation of all water on earth, commonly called the hydrologic cycle. The hydrologic cycle begins with precipitation falling on the land surface. Some of the water runs off into streams and lakes, some infiltrates into the earth and becomes ground water, and a third portion evaporates back into the atmosphere. The portion which becomes ground water ultimately discharges into streams, lakes, and other surface water bodies. The water in streams and rivers flows into lakes and oceans where it is evaporated into the atmosphere. Water in the atmosphere eventually falls as precipitation on the earth's surface and starts the cycle all over again. More information on the hydrologic cycle may be obtained from the Division of Water fact sheet number 18, entitled "The Hydrologic Cycle."

Like water in streams and rivers, ground water moves, but at a very slow rate. Ground water flow is usually measured in terms of feet per day; in some formations ground water flow may only be a few inches per year.

Ground water flows from areas where precipitation percolates down to the water table, called recharge areas, to locations where it flows out of an aquifer and becomes surface water. If ground water flows out of an aquifer at the land surface, that spot is called a "spring." Most ground water, however, flows directly into streams, rivers, lakes, and wetlands through the stream bed or the bottom of the lake or wetland. Have you ever wondered why streams and rivers still flow during periods of drought? Most of the flow in streams and rivers during drought times is ground water discharging from aquifers into the stream channel. Hydrologists call this component of stream flow "base flow." Base flow can also be a significant component of stream flow during normal times. In many streams, base flow sustains aquatic life during prolonged dry spells.

How Important Is Ground Water?

Over 98 percent of the available fresh water on earth is ground water. According to the USEPA, 48 percent of the population of the United States relies on ground water to meet its daily water needs. In Ohio, over 40 percent of the population (more than 4.5 million people) depends on ground water. This includes large municipalities, such as Dayton, Canton, and Columbus, which rely on ground water to provide all or part of their water supply, and over 700,000 domestic water wells supplying individual homes throughout the state.

Industries in Ohio pump over 240 million gallons of ground water per day; irrigation withdrawals total almost 2 million gallons per day. Total ground water pumped for all uses in Ohio is 730 million gallons per day. That's over 266 billion gallons per year, enough water to flood the entire City of Columbus to a depth of almost 7 feet.

Where Is Ground Water Found?

Although the quantity of ground water used in Ohio is impressive, ground water does not occur everywhere with the same prevalence. The most productive aquifers in the state are the buried valley aquifers in the southwest, south-central, and east-central portions of the state. These aquifers consist of thick layers of sand and gravel deposited in valleys eroded deeply into the surrounding bedrock.

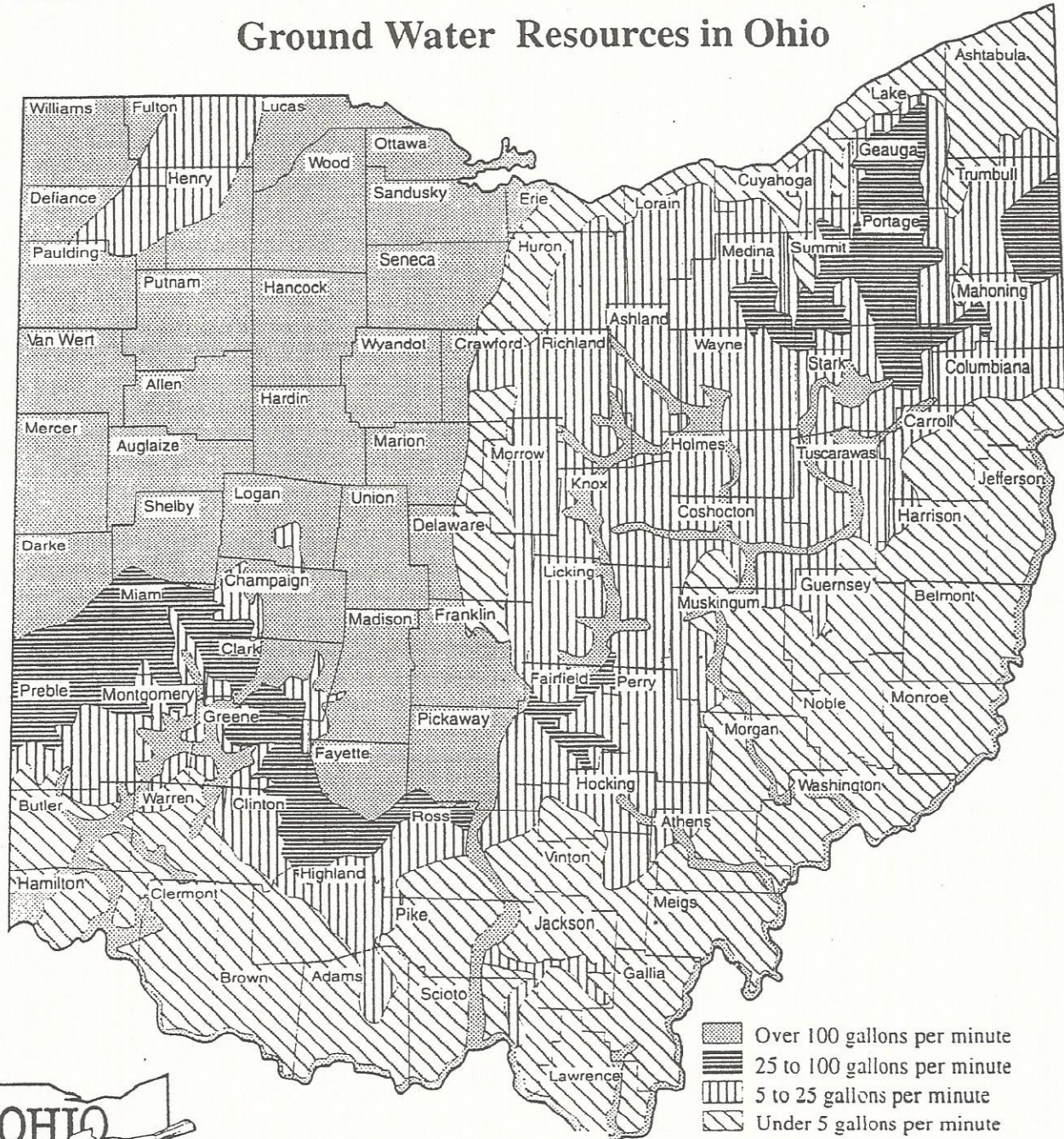
Some of the poorest aquifers in the state occur where the bedrock resists the flow of ground water. These types of formation are especially prevalent in the southeast portion of state, but also occur in some parts of the southwest and south-central portions of the state, and in a band along the eastern Lake Erie shore. The bedrock aquifers in these locations contain a very high percentage of clay minerals. Formations with high clay content are poor aquifers because they have very few or very small pore spaces for ground water to be stored in, or flow through.

The map below illustrates, in a very general way, the availability of ground water in Ohio.

If you would like more information about ground water in general, or if you have a question about the occurrence of ground water at a particular location in Ohio, give us a call or stop by. Our phone number and address are:

Ohio Department of Natural Resources
 Division of Water
 Water Resources Section
 1939 Fountain Square
 Columbus, OH 43224-1336
 Voice: (614) 265-6740 Fax: (614) 265-6767
 E-mail: water@dnr.state.oh.us
 Web site: <http://www.dnr.state.oh.us/odnr/water/>

Ground Water Resources in Ohio



Ground-Water Movement

Introduction

Ground water must be able to move through underground materials at rates fast enough to supply useful amounts of water to wells or springs in order for those materials to be classified as an aquifer. For water to move in an aquifer, some of the pores and fractures must be connected to each other. Water moves through different materials at different rates, faster through gravel, slower through sand, and even slower through clay. Gravels and sands are possible aquifers; clays usually are not aquifers. The following activity demonstrates how different sizes of rock materials that make up an aquifer affect water movement.

Objectives--Students will:

1. Identify several sources of rock materials that make up an aquifer.
2. Discuss how water moves through gravel, sand, and clay.

Materials

1. At least 10 students.
2. Large area to conduct activity.

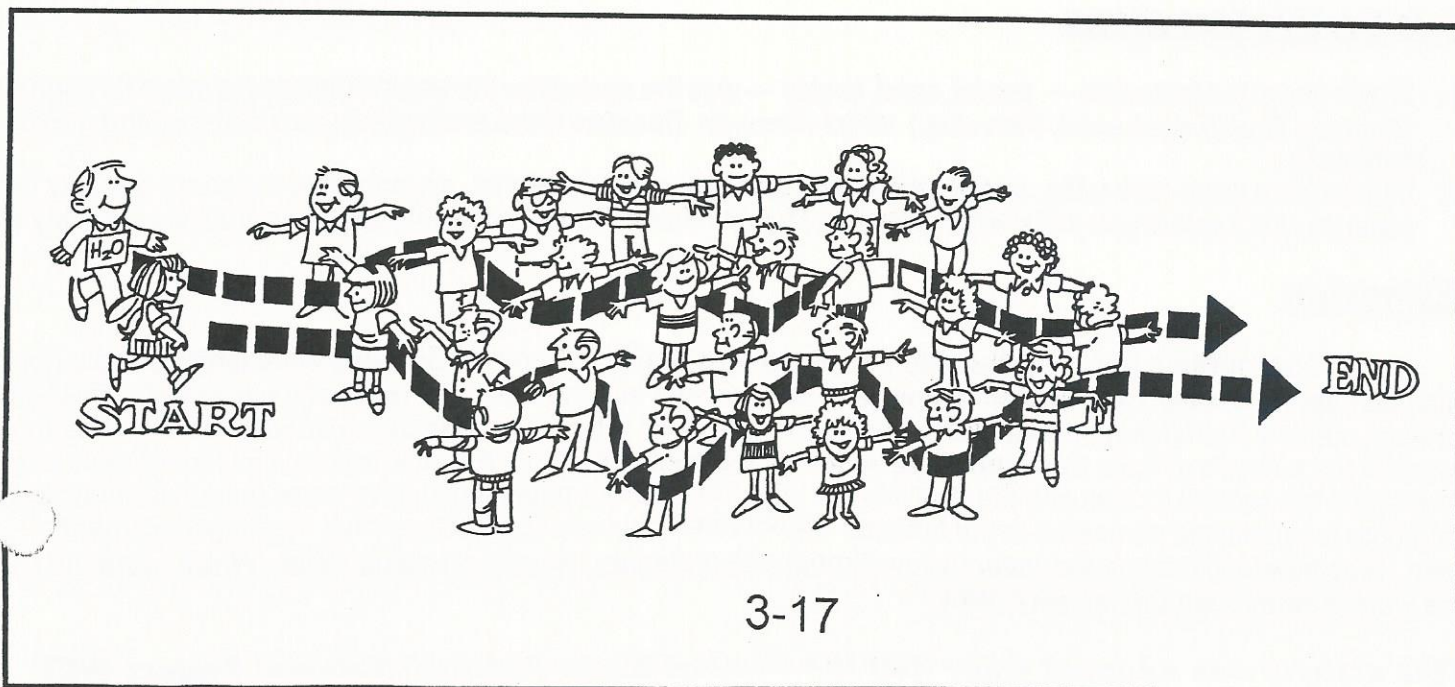
Teacher Preparation

This activity can be conducted in the classroom, gymnasium, or outside the school building. If conducted in the classroom, move all furniture to allow for sufficient room for the movement of students. This is a three-part demonstration that may create some excitement.

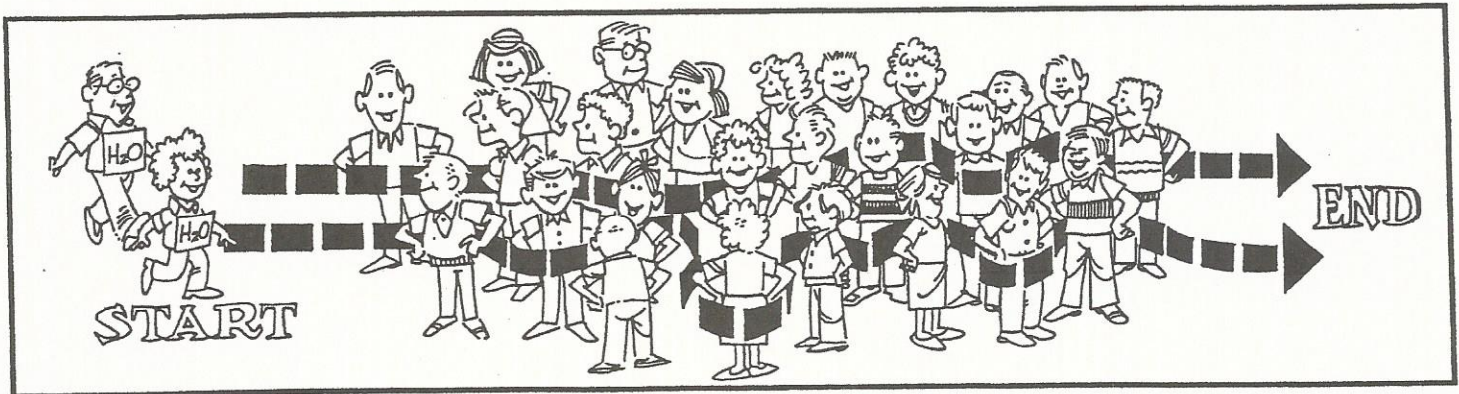
Procedures

Select two or three students to be molecules of water. The remaining students will be rock materials.

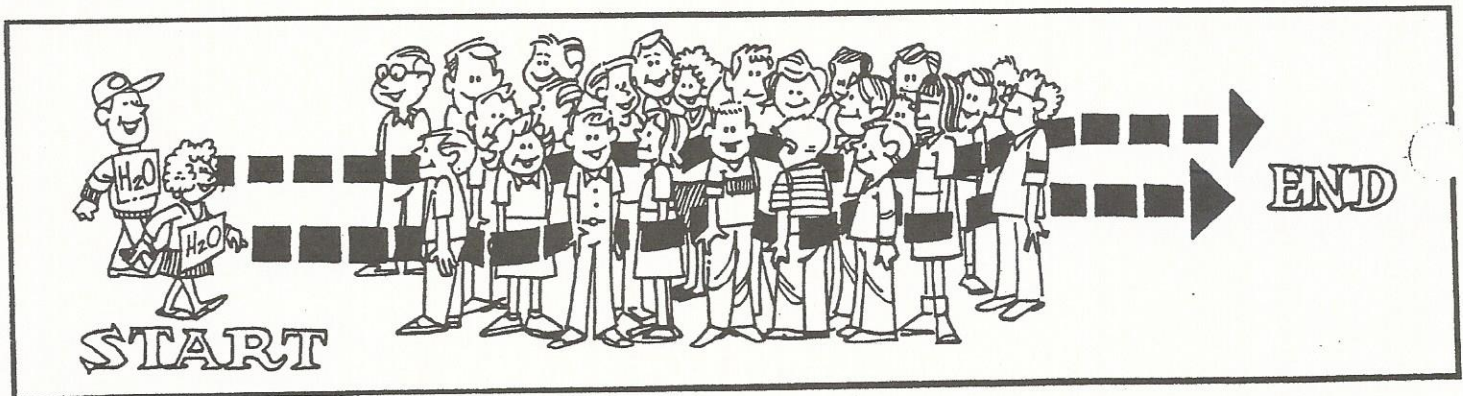
1. **Activity One:** Water movement through gravel. The students represent gravel by holding arms outstretched, leaving a 15- to 30- centimeter (cm) space between their outstretched arms. Locate these students in the center of the activity area. The students representing water molecules are to start on one side of their "gravel" classmates and move through them, exiting on the other side. The water molecules will move easily through the gravel.



2. **Activity Two:** Water movement through sand. The students represent sand by extending arms, bending them at the elbows and touching their waists with their fingers. Locate these students in the center of the activity area, spacing them approximately 15 cm apart. Once again, have the water molecules slowly make their way through their "sand" classmates. The water molecules will experience some difficulty, but should still reach the other side.



3. **Activity Three:** Water movement through clay. Students become clay particles by placing their arms straight down the sides of their bodies and standing approximately 10 cm apart. Locate these students in the center of the activity area. It will be a formidable task for water molecules to move through the clay. Without being rough, the water molecules should slowly make their way through the clay. The water molecules may not be able to move through the clay at all.



Interpretive Questions

1. Which one of the materials — gravel, sand, or clay — was the easiest for the water molecules to move through? (Answer: Gravel, then sand, then clay.) Why? (Answer: Because there are larger spaces between the gravel particles.)
2. If there were three rock units, one of gravel, one of sand, and one of clay, all containing the same quantity of water, in which would you drill a well? (Answer: Gravel. Water moves easier through gravel than sand or clay.)

Extension

Obtain 250 milliliters (mL) of sand, 250 mL of pea-size gravel, 250 mL of clay, and three large funnels (top diameter approximately 12 cm). Force a piece of cheesecloth into the top of the spout of each funnel. This will prevent material from going through the funnel spout. Put each funnel into separate clear containers so that the spout of the funnel is at least 5 cm above the bottom of the container. Pour the sand into the first funnel, pea-size gravel into the second funnel, and the clay into the third funnel. Pour equal amounts of water (approximately 200 mL) onto the materials contained in the funnels. Select three students to pour the water, creating a permeability race. Time how long it takes the water to flow through the materials. Record on a data sheet. Which material did the water flow through the fastest? Why?

This activity was adapted from "Get the Ground Water Picture," National Project WET.

ACTIVITY

Recharge - Discharge

Introduction

Recharge is the addition of water to an aquifer. Recharge can occur from precipitation or from surface-water bodies such as lakes or streams. Water is lost from an aquifer through discharge. Water can be discharged from an aquifer through wells and springs, and to surface-water bodies such as rivers, ponds, and wetlands. The following activity is designed to demonstrate the recharge and discharge of water to a model aquifer.

Objectives--Students will:

1. Identify several sources of recharge for ground water.
2. Identify several sources of discharge for ground water.
3. Discuss how water moves from recharge to discharge areas.
4. Discuss the connection between surface water and ground water.

Materials

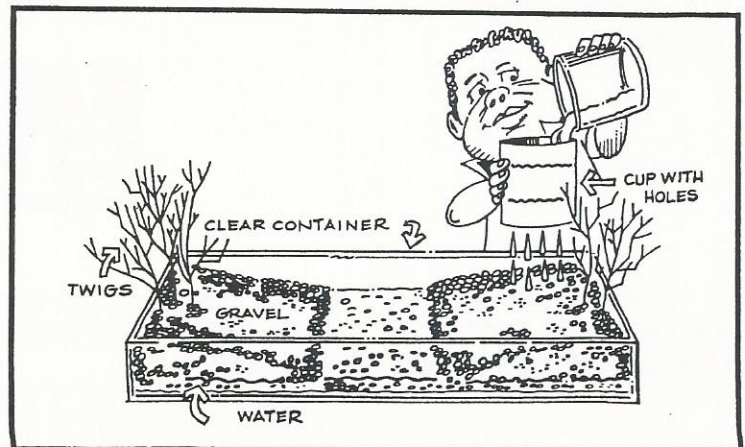
1. One clear container at least 15-cm wide x 22-cm long x 6-cm deep for each group. Possible containers include clear plastic salad containers or clear baking pans.
2. Sufficient pea-size gravel to fill the container approximately 2/3 full.
3. Two 472-mL paper cups for each group.
4. One pump dispenser from soft-soap or hand-lotion containers for each group.
5. 472 mL of water.
6. Grease pencils, one for each group.
7. Twigs or small tree branches, to represent trees on the model (optional).
- o Colored powdered-drink mix or food coloring (optional).

Teacher Preparation

1. Display a copy of the poster titled "Ground Water: The Hidden Resource" on the classroom wall several days prior to conducting this activity.
2. Using an ice pick or awl, punch 8 to 10 small holes in the bottom of one of the paper cups. When filled with water, this cup will be used to simulate rain.
3. Fill the clear containers 2/3 full with pea-size gravel.

Procedure

- Divide the class into small groups. Provide each group with one clear container filled 2/3 with pea-size gravel, one 472-mL cup with holes punched in the bottom, one 472-mL cup with no holes, and one pump dispenser.
- Students make models to represent hills and a valley. One student from each group fills the 472-mL cup without holes in the bottom with water. Each group makes a valley in the center of the model by pushing gravel to the farthest opposite ends of the container so the valley extends completely across the width of the container. About 2 cm of pea-sized gravel remains in the bottom of the valley.



- Explain to the students that the gravel mounds on both sides of the container represent hills with a valley in between. The students can place twigs or small branches on the hills to represent trees. Instruct a student to hold the 472-mL cup with holes over the model. Then add 472 mL of water to this cup. Tell the students that they are simulating rain. Have the students observe how the water infiltrates into the gravel and becomes ground water.
- Introduce the word recharge—the addition of water to the ground-water system. Observe that water is standing in the valley. Have the students use a grease pencil to draw a line identifying the water level in the container. The line should traverse the entire model, identifying the water level under the hills and in the valley. There will be a pond in the valley.
- Explain that they have just identified the top of the ground water in their model. The top of the ground water is called the water table. Discuss with the students how the ground water becomes a pond in the valley. This is because the water table is higher than the land surface (gravel) in the valley.
- Have the students insert the pump into one of the hills on the side of the valley, pushing the bottom down to the ground water. Allow each of the students in the group to press the pump 20-30 times after the water in the pump has begun to flow. Catch the water in the paper cup with no holes in the bottom. After each student takes a turn pumping, instruct them to observe the location of the water table in relation to the grease-pencil line. Where did the water go? What happened to the pond? Discuss discharge, the removal of water from the ground. Discuss the effect of ground-water pumping on streams and lakes.

Interpretive Questions

1. Where does ground water come from?

Answer: Precipitation (rain, snow, sleet, etc.) Also, if the water table is at or below the surface of the water in a stream or pond, water can move from the stream or pond to recharge the ground-water system.

2. What would happen in the students' neighborhood (name a local stream or pond) if a well was drilled near stream or pond and enough water pumped to lower the water table around the stream or pond?

Answer: Some water from the stream or pond would be removed by the pump through the well. If enough water is removed, a pond or small stream could go dry.

Extension

Sprinkle a colored powdered-drink mix or food coloring on top of one of the hills and repeat the above activity by having it rain on the model. Discuss the movement of "pollution" from the hill to the ground water to the lake.

ORDERING INFORMATION

Single copies of the first three posters in the series (see Poster Series panel) and a limited supply of the "Ground Water" poster (color for grades 3-5 and 6-8 or black and white) can be obtained at no cost from the U.S. Geological Survey.

U.S. Geological Survey
 Box 25286
 Denver Federal Center
 Denver, CO 80225
 Telephone: (303) 236-7477

Also, the poster entitled "Water: The Resource That Gets Used & Used & Used for Everything!" has been translated into Spanish. A limited supply of color or black-and-white copies can be obtained at no cost from U.S. Geological Survey at the above address.

THE GROUNDWATER CHALLENGE

Objective

To build the most efficient water filtration device using the items they are given.

Materials

Filter Materials (you will need the following items for each team)

- ⊗ 2 cups of gravel
- ⊗ 2 cups of sand
- ⊗ ½ cup of activated charcoal
- ⊗ Sponge
- ⊗ Coffee filter
- ⊗ Paper clip
- ⊗ Straw
- ⊗ Cotton ball
- ⊗ 2-liter pop bottle, cut in half
- ⊗ Rubberband
- ⊗ Tape
- ⊗ Panty-hose
- ⊗ Modeling clay or putty
- ⊗ Scissors
- ⊗ Yarn, 12" long

Contamination Materials

- ⊗ Large bucket filled with water
- ⊗ Food coloring
- ⊗ Raisins
- ⊗ Potting soil
- ⊗ Baking soda
- ⊗ Soy sauce
- ⊗ Paper plate, ripped into small pieces

Source

The Groundwater Foundation

Background

Have you ever wondered how a municipal water treatment plant is designed? It is an intricate and tedious process that has gone through many years of work to create the modern water treatment processes we see today.

Procedure

In Advance

1. Decide how many teams you want and how many students will be on each team. We recommend smaller teams of 2-3 students as to allow all students the opportunity to get involved.
2. Each team will need one 2-liter pop bottle, cut in half. Take the top portion of the bottle and turn it upside down and place it in the bottom portion. The filter will be built inside the inverted, top portion of the bottle. The base portion will act as a reservoir and collect the water that runs out of the filter.
3. Now make the contamination liquid that will be poured through the students filter. Take the bucket of water and mix in the "contamination materials". The food coloring represents chemicals, the raisins represent animal/human waste, the potting soil represents earth, the baking soda represents road salt, the soy sauce represents motor oil, and the torn paper plate represents litter.

Activity

1. Discuss filtration systems with students
2. Provide each team with the filter materials and explain to them that they have been hired by a water treatment plant to design the most efficient water filtration system possible with the materials supplied. The teams may only use eight items, not counting the pop bottle, to construct their filtration device. Grant them fifteen minutes to discuss and construct their filter.
3. At the end of the fifteen minutes, pour the "contaminated" water on to the top of each of the filtration systems. This part can be messy, so it's best to move outside. The team that has the clearest, most debris free water in its collection base is the declared the winner.

Taken from **Making a Difference**, Groundwater Activities for the Classroom and Community. Groundwater Foundation, 2000

**Science Standards Correlations Project
Activities by Grade Level Band—Ground Water Flow Model**

K-2	3-5	6-8	9-10	11-12
NA	Ground Water Flow Model Presentation	Ground Water Flow Model Presentation	Ground Water Flow Model Presentation	Ground Water Flow Model Presentation
	Get the Ground Water Picture, Part I	Get the Ground Water Picture, Part III	Get the Ground Water Picture, Parts I & III	Get the Ground Water Picture, Parts I & III
	Ground Water Movement	A Grave Mistake	A Grave Mistake	A Grave Mistake
	Recharge - Discharge	Ground Water Challenge	Ground Water Challenge	Ground Water Challenge