AWESOME AQUIFERS

Event Guide

Organize an Awesome Aquifers Tournament

This guide is written for event supervisors, team coaches and judges who are organizing an Awesome Aquifers (AAB) competition for a Science Olympiad tournament.

Awesome Aquifers is a fun event that utilizes geology, earth science, hydrology, and meteorology topics.

This event will challenge student's creativity by incorporating skills in three-dimensional model building, public speaking, thinking on the fly, and scientific research.

During the competition, teams of up to two students complete two written tests and build an aquifer that demonstrates an understanding of groundwater's role in the hydrologic cycle, the physical makeup of an aquifer, changes to the groundwater system, contamination, clean-up, and more.

This guide includes sample test questions, model making ideas, and possible demonstration concepts to help you prepare for competition.

The event Awesome Aquifers was designed by The Groundwater Foundation, a nonprofit organization that educates people and inspires action to ensure sustainable, clean groundwater for future generations

Learn more at www.groundwater.org.

You can run it!

1. Understand the event rules.
2. Recruit judges.
3. Write tests, select concepts.
4. Prepare the competition area.
5. Run the event, tally scores.
6. Have fun.

SCIENCE OLYMPIAD

Exploring the World of Science

AAB EVENT GUIDE

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Official Rules for Competition: Awesome Aquifers

AWESOME AQUIFERS

1. **DESCRIPTION:** Students will construct an aquifer and answer questions about groundwater concepts.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME**: 50 Minutes

2. **EVENT PARAMETERS:** The supervisor will supply score sheets, water, Station 2 resources, and Station 3 building objectives. Students are required to bring any materials needed to assemble an aquifer on-site. The entire aquifer is to be housed in one transparent container not exceeding a total volume of 3 liters. This container can be cut or punctured in advance but must be brought to the competition empty. Electric pumps/tools and commercial flow models are not allowed. Students cannot bring notes, texts, or references. Students are responsible for taking and/or properly disposing of all materials used in assembling their aquifer. An extended list of suggested materials and possible concepts are available at http://www.groundwater.org/pe/so_aa.html and may include but not limited to material such as:

   a) Sand and gravel (such as pea-sized or aquarium gravel)
   b) Modeling clay or plumber's putty
   c) Materials for wells and pumps, such as soap bottle pumps or aquarium tubing and plastic syringes. No electric or commercial pumps permitted.
   d) Well screening materials, such as nylon hose, cotton, coffee filters, etc.
   e) Sponge
   f) Aluminum foil and/or plastic wrap or sheeting
   g) Empty 35 mm plastic film canisters or equivalent
   h) Material to represent contaminants, such as food coloring or powdered drink mix
   i) Materials that could be used for remediation such as coffee filters, fabric squares, charcoal, etc.
   j) Items useful in creating or demonstrating the aquifer but that will not be part of the aquifer, such as scissors, tacks, tape, containers to hold water and/or contaminants, blank paper, pen or pencil, etc.

3. **THE COMPETITION:** Students will be given 10 minutes to complete each station.

   a) Station 1: Students take a written test on groundwater concepts and vocabulary. Questions can be multiple choice, true/false, fill in the blank, or short answer.
   b) Station 2: Students take a written test utilizing provided resources such as maps, charts, graphs, models, and scientific publications. Questions can be multiple choice, true/false, fill in the blank, or short answer.
   c) Station 3: Students build an aquifer that will explain and demonstrate concepts chosen by the event supervisor. Students may create notes at Station 3 to use at Station 4. Possible concepts include but are not limited to: recharge, discharge, connection between surface and groundwater, water table, porosity, permeability, well location and abandonment, groundwater contamination, remediation, and safe yield from an aquifer. See list of presentation concepts for regional, state, and national tournaments at Awesome Aquifer event page at www.soinc.org.
   d) Station 4: Students use the aquifer built at Station 3 to explain and demonstrate the required concepts to a judge(s). Information may be presented in any way or order students choose and the same demonstration may be used to explain more than one concept. Judge(s) may ask clarifying questions but only if a team has finished its demonstration and there is time remaining.

4. **SCORING:** Highest score wins. Station 1-25%, Station 2-25%, and Station 4-50%. First tiebreaker: highest score at station 4. Second tiebreaker: highest score on pre-selected questions at station 1 and 2. Answers must include units where appropriate.

Recommended Resources: All reference and training resources including the **Awesome Aquifer DVD** are available on the Official Science Olympiad Store or Website at www.soinc.org

THIS EVENT IS SPONSORED BY THE GROUNDWATER FOUNDATION (www.groundwater.org/pe/so_aa.html)

Sample Score Sheet: Awesome Aquifers

Awesome Aquifers Score Sheet

Name(s): _____ Raw score/rank: _____

School Name: _____Team Number: _____ State: _____

Point Totals

	Possible	Total
Station 1: Test	15	
Station 2: Test	15	
Station 4: Demonstration Points	30	
Total Stations 1, 2, 4	60	
1st Tiebreaker: Highest score at Station 4	.5 pt	
2nd Tiebreaker: Highest score on pre-selected demonstration items/test questions—.01pt per question needed to break a tie	.01 pt each	
Total Points		

Station 1:

1._____
2._____
3._____
4._____
5._____
6._____
7._____
8._____
9._____
10._____
11._____
12._____
13._____
14._____
15._____

Station 2:

1._____
2._____
3._____
4._____
5._____
6._____
7._____
8._____
9._____
10._____
11._____
12._____
13._____
14._____
15. _____

Team Score Sheet

Each team will be given one copy of this score sheet at the beginning of competition. Teams will use the lower half of the sheet to record their answers to the written tests at Station 1 and 2. The event supervisor will complete the points section of this form before turning in to SO officials at the conclusion of the tournament.

This score sheet can be downloaded as a PDF or Word document from www.groundwater.org/pe/so_aa.html or be recreated.

Recruiting Judges and Other Volunteers

Students and Professionals

Often water professionals are very eager to volunteer their time to work directly with students on a mentoring level to help them prepare for tournaments.

The format of this event is unique in that it brings students closer to water professionals. This opens the door of opportunity for career exploration in an often over-looked branch of science occupations.

An Awesome Aquifers event requires groundwater expertise for two purposes: Designing two tests, a building concept list, and judging the built portion of the competition. You may have this expertise as an event supervisor or you may need to recruit some assistance.

Look for expertise among the following entities and individuals:

- US Geological Survey (USGS)
- State geological survey or natural survey
- US Environmental Protection Agency (US EPA)
- State environmental or health agencies
- US Natural Resources Conservation Service (NRCS)
- Bureau of Reclamation
- Natural resources, conservation, groundwater, and irrigation districts
- Water utilities or water management agencies
- Engineering or environmental firms
- Professional well drillers
- Educators knowledgeable about groundwater
- Cooperative Extension specialists
- Local health departments with environmental specialists
- City or county engineers
- Universities and colleges

You will need at least one judge per team demonstration at Station 4. If you have a larger event (state or nationals) you will need to run multiple stations simultaneously, thus requiring more judges. This is explained in more detail throughout this guide.

Consider pairing two judges per demonstration. Team judging generally improves consistency, but it also increases the time needed to judge each team slightly because judges will need a few moments to compare their scores at the end of each demonstration.

Judges will need to familiarize themselves with Awesome Aquifers prior to the event. Judges can significantly increase their understanding of the event and comfort level as judges if they try building a model aquifer and demonstrating the Awesome Aquifers concepts prior to the tournament. At a minimum judges will want to review the rules and score sheets prior to the start of the event.

Recruiting (cont.)

In addition to judges, you may want volunteers to help students register for time slots, check in students as they arrive and assign them to stations, monitor different stations, serve as timekeepers, and grade student answers. You can combine or split all volunteer jobs to suit your needs.

Except for judges, volunteers don't need expertise in groundwater. Your tournament director may have a volunteer pool and can assign the help you need. If not, here are some other possibilities:

- Classroom teachers, retired educators
- College students
- High school students
- Community volunteer organizations, i.e. Key Club, Rotary Club
- Colleagues
- Friends and family

You will need someone to serve as the official timekeeper who can operate a stopwatch and let all groups know when it's time to stop their work and move to the next station. It's helpful if the timekeeper calls a warning when one minute is left in a round.

The score sheet and total points can be modified to suit your event, however half the competition points must come from the demonstration and half come from the written tests combined. The first tiebreaker is the highest score on the demonstration, and the second tie breaker is the highest score on pre-selected questions.

All ties must be broken. Using 0.5 points for the first tiebreaker and 0.01 points for each question on the second tiebreaker should allow all ties to be broken according to the rules while still allowing all teams to be ranked using raw scores. Select several questions in advance for the second tiebreaker. For example, you might decide to use Test 1: question 2, 4, 6, 8, 10, 12. Consider selecting your more difficult questions to use as tiebreakers.

Keep in mind: The rules don't allow for partial points for partially correct answers or partially successful built aquifer requirements.

Look for volunteers in obvious as well as uncommon places.

Station 1: Hydrology Test

Teams will have 10 minutes to complete a written test covering groundwater concepts and vocabulary.

Event supervisors are responsible for writing this test. Please use this sample test as a guide in creating an original test for your event. This test must contain the same number of questions as the Station 2 test (we recommend 10-15 questions).

Questions can be formatted as multiple choice, true/false, fill in the blank, short answer or a combination of both.

Questions should become more challenging as students move from a regional tournament to Nationals.

Station 1 counts as 25% of a team's total score.

Refer to glossary on page 24 important groundwater terminology.

Station 1: Sample Test Questions

1. A hole or shaft drilled into the earth to pump water to the surface is referred to as a:
   A. sink hole B. spring
   C. water supply (D.) well
2. An outflow of water from a stream, pipe, groundwater aquifer, or watershed is called:
   A. recharge B. dismiss
   (C.) discharge D. ejection
3. Material that allows water to penetrate through it is considered:
   A. leaky B. absorbent
   C. resistant (D.) permeable
4. The process of lowering the groundwater level through pumping a well is called:
   (A.) drawdown B. attenuation
   C. reduction D. dwindling
5. The solid rock beneath the soil and superficial rock is:
   A. foundation B. core rock
   (C.) bedrock D. base
6. Water that does not become absorbed by the earth but flows across the surface of the land into a stream or lake is called:
   (A.) runoff B. overflow
   C. overspill D. discharge
7. The flow of water from the land surface into the subsurface is:
   A. permeation B. admission
   C. penetration (D.) infiltration
8. An aquifer containing groundwater that has an impermeable layer below but not above it is called a(n):
   (A.) unconfined aquifer B. confined aquifer
   C. restricted aquifer D. upper aquifer
9. The zone immediately below the land surface where the pores and fractures contain both water and air is the:
   A. confining zone B. withdrawal zone
   (C.) unsaturated zone D. saturated zone
10. What is the term that describes or measures the open or void spaces in rocks or sediments?
    A. permeability (B.) porosity
    C. absorbency D. sustainability

Station 2: Sample Test Questions

1. In figure 1, what is the proper name for area A?

   A. saturated zone

   B. unsaturated zone

   C. polyunsaturated zone

   D. free fall zone

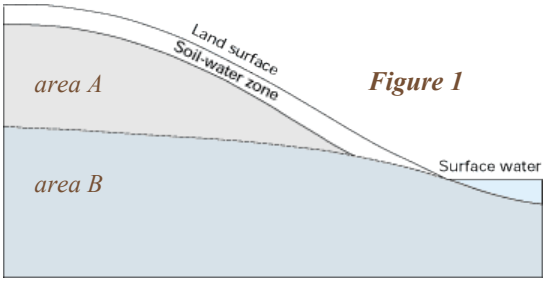


Figure 1

2. What would you expect to find in the voids (spaces between the sediment particles) throughout most of area B in figure 1?

   A. worms B. roots and other living plant materials

   C. air and a little water D. water

3. In figure 1, the line separating area A and area B is known as the ____.

   A. water line B. hydroequalization gradient

   C. aquatic differentiation margin D. water table

4. Which of the following would be the most likely type of material in the confining layer in figure #2?

   A. sandstone

   B. gravel

   C. granite

   D. topsoil

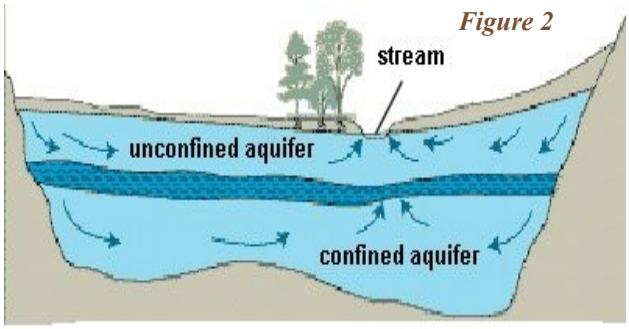


Figure 2

5. What is the relationship between the stream and the unconfined aquifer in figure 2?

   A. water is moving from the stream into the aquifer

   B. water is moving from the aquifer into the stream

   C. there is no relationship between the stream and the unconfined aquifer

   D. None of these answers are possible based upon information provided

High hydraulic-conductivity aquifer

Low hydraulic-conductivity confining layer

Very low hydraulic-conductivity bedrock

Indicates direction of groundwater flow

6. In figure 2, which body of water would probably have the highest rate of flow?

   A. groundwater in the unconfined aquifer B. surface water in the stream

   C. confining layer D. None of the above; they have equal flow rates

Station 2: Resource Test

Teams will have 10 minutes to complete a written test covering groundwater concepts and occurrences using maps, charts, graphs, booklets, textbooks, models and/or other resources as provided by the event supervisor who is also responsible for writing this test.

Please use this sample test as a guide in creating an original test for your event. This test must contain the same number of questions as the Station 1 test (we recommend 10-15 questions).

Questions will be formatted as multiple choice, true/false, fill in the blank, short answer or a combination of both.

Questions should become more challenging as students move from a regional tournament to Nationals.

Station 2 counts as 25% of a team's total score.

Find sample resources to create tests at www.groundwater.org and page 8 of this guide.

Station 1-2: Writing Original Tests

Writing Original Tests

There are lots of places to look to for inspiration when writing your own, original tests for Stations 1 and 2. Examples of approved scientific sites are listed to the right.

The Groundwater Foundation and Science Olympiad encourage new tests to be written for each tournament in order to maintain the spirit of the competition while minimizing the opportunity for advantages or cheating.

Take caution when composing fill-in-the-blank or essay type questions. They can be difficult to grade fairly.

Keep in mind that the combined point value for the tests at Station 1 and 2 needs to be equal to the point value assigned to Station 4. Feel free to tweak point values, number of questions/concepts as needed.

If you require additional assistance in developing your tests, email The Groundwater Foundation at joltman@groundwater.org.

THE GROUNDWATER FOUNDATION www.groundwater.org

- Groundwater and the Water Cycle—http://www.groundwater.org/kc/gwwatercycle.html
- Wells and How They Work—http://www.groundwater.org/gi/wells.html
- Sources of Groundwater Contamination—http://www.groundwater.org/gi/sourcesofgwcontam.html
- Groundwater Glossary—http://www.groundwater.org/gi/gwglossary.html

USGS (United States Geological Survey) www.usgs.gov

- Posters— http://water.usgs.gov/outreach/OutReach.html
- Ground Water booklet—http://capp.water.usgs.gov/GIP/gw_gip/index.html
- What is Ground Water?— http://pubs.usgs.gov/fs/OFR93-643/
- Earth's Water: Ground Water—http://ga.water.usgs.gov/edu/earthgw.html
- Ground Water and Surface Water: A Single Resource, Circular #1139—http://pubs.usgs.gov/circ/circ1139/
- Sustainability of Ground-Water Resources, Circular #1186—http://pubs.usgs.gov/circ/circ1186/
- Estimated Withdrawals from Principal Aquifers in the United States, 2000 ed.—http://pubs.usgs.gov/circ/2005/1279/
- Estimated Use of Water in the United States in 2000—http://pubs.usgs.gov/circ/2004/circ1268/index.html
- Groundwater and Its Involvement in the Water Cycle—http://ga.water.usgs.gov/edu/watercycle.html
- Groundwater and the Rural Homeowner—http://pubs.usgs.gov/gip/gw_ruralhomeowner/

US EPA (United States Environmental Protection Agency) www.epa.gov

- Magnificent Ground Water Connection—http://www.epa.gov/region01/students/teacher/groundw.html
- Drinking Water & Groundwater Kid's Stuff: Classroom Lessons—http://www.epa.gov/ogwdw/kids/teachers_4-8.html
- All About Wetlands—http://www.epa.gov/OWOW/wetlands/index.html
- What is an Aquifer?—http://www.epa.gov/superfund/students/clas_act/haz-ed/aquifer.htm
- Fact Flash on Groundwater—http://www.epa.gov/superfund/students/clas_act/haz-ed/ff_05.htm

Station 3: Sample Model Building

Station 3: Model Building
(Student Worksheet)

Using the materials you brought, build a model that can be used to explain and demonstrate the concepts listed below. Concepts can be presented in any order.

CONCEPTS define, explain, and demonstrate
Connection between surface water and groundwater
Porosity between 2 different materials
Permeability between 2 different materials
Importance of well siting
Importance of well closure
Impact to surface water bodies from a well
Give example of actual pollutant and how it reaches groundwater
Movement of a contaminant in groundwater
Remediation of groundwater contamination
Sustainable (safe) yield from an aquifer

Station 3 Student Worksheet

Each team will be given one copy of a similar worksheet when the team begins their 10 minutes at Station 3.

Event supervisors are responsible for pre-selecting a list of concepts. 10-15 concepts are recommended for the time allotted. Please use this sample list as a guide in creating an original list for your event. More concepts can be found on page 12. This list will be incorporated in the judge worksheet (sample on page 13).

Concepts should become more challenging as students move from a regional tournament to Nationals.

Station 3: Model Building

Teams are given 10 minutes to construct one aquifer model at Station 3. While at Station 3, students may take notes that can be used during their presentation at Station 4. These notes cannot be used at any other station or leave the competition room; they should be collected by the judge(s).

While building at Station 3, teams will be provided with the list (page 9) of selected concepts to incorporate into their model. See page 12 for a list of possible concepts.

Models can be built from a variety of items at little to no cost. Examples of materials that are and are not allowed are listed on the right.

Station 3: Sample Supply List

CONTAINER IDEAS

Rules require teams to bring one transparent container with a volume that does not exceed 3 liters. Teams will construct their model inside this container. If desired, this container can be cut or punctured prior to competition, but must be carried in to the tournament EMPTY. This container can hold smaller containers within and/or be partitioned into sections. Commercially produced groundwater flow models are not allowed.

- Plastic storage bin (common manufacturers include Rubbermaid, Sterilite, etc.)
- Plastic food container (common manufacturers include Ziplock, Gladware, etc.)
- 2 liter soda bottle, juice bottle, or similar; cut any way
- Acrylic display box (for collectibles like Beanie Babies)
- Small pet aquariums (for fish, reptiles, hermit crabs, etc.)
- Other
- Students may wish to bring additional smaller containers (drinking cups, beakers, squeeze bottles, 35mm film canisters, salt shakers, etc) to put inside the larger container, or use externally to store water or a "mock" contaminant. This use of additional containers is permitted.

MATERIAL IDEAS

This is a sample list of possible items that may be used to build an aquifer, strata layers, wetlands, lakes, rivers, wells, water treatment (remediation) techniques, etc. There is no limit to the number of items included inside a model, however simple models often out perform complex ones. Students are required to bring their own supplies to the tournament.

- Sand (play or beach)
- Gravel (various sizes: aquarium, pea, landscape, lava, quartz, etc.)
- Potting soil
- Sponge (kitchen or natural)
- Floral foam (used in flower arrangements), styrofoam
- Coffee filter paper, cotton balls
- Tubing (aquarium air line), drinking straws, plastic hose (represent a well)
- Hand pump from a soap or lotion bottle (represent a well)
- Plastic syringe (obtain from a medical supply store or veterinarian – attach to tubing to function as a well pump)
- Panty hose, cheese cloth, window screen (attach to the bottom of a well to keep well from clogging – represent a well screen)
- Green astro turf, carpet or door mat (represent a lawn or farm)
- Modeling clay or plumber's putty (use to make confining layers as well as an adhesive to hold smaller items in place)
- Squirt bottle, squeeze bottle or spray bottle (hold water or a contaminant)

Station 3 (cont.)

- Aluminum foil, cling wrap, plastic sheeting
- Plastic aquarium plants, toy buildings/people, sticks and twigs (decorative)
- Other

CONTAMINATION IDEAS

This is a list of items that may be used to contaminate and/or remediate a model. The students should use only items that represent a contaminant. For safety reasons, the use of actual hazardous and harmful chemicals is not allowed (motor oil, fertilizer, bleach, etc.)

- Powder drink mix (Kool-Aid, hot cocoa, instant tea, etc.)
- Liquid food coloring (diluted with water)
- Activated charcoal (for aquariums)
- Baking soda and vinegar
- Coffee filters, sponges, cotton balls, etc.
- Other

ADDITIONAL HELPFUL SUPPLIES

Students may bring additional items to assist with designing and assembling, their model. Electric pumps, power tools, and other motorized equipment is not allowed in the competition area for safety reasons.

- Scissors, craft knife
- Tape (electrical, duct, etc.)
- Thumb tacks (poke drainage holes in something)
- Cups, beakers
- Scoops, medicine cups, spoons
- Eye dropper or pipette
- Rubber bands
- Toothpicks, wooden dowels
- Pencil and blank paper (making notes/drawings)
- Other

View more photos of models online at www.groundwater.org.

Station 4: Sample Presentation Concepts

Station 4: Presenting

Teams have 10 minutes to thoroughly explain (verbally define and give examples) AND demonstrate (manipulate their model to show) the pre-selected concepts in any order or format at Station 4. Teams may refer to notes and/or the concept list (page 9) while presenting.

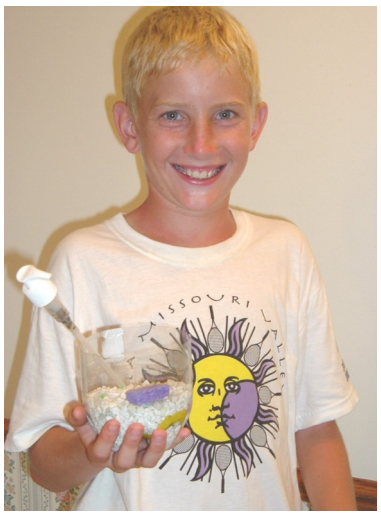
Possible concepts are listed on the right.

Event supervisors will select concepts and determine points for each concept prior to competition. Point values are to be based on the complexity of the concept.

Teams earn points for comprehensiveness, accuracy, and clarity (not artistic appeal).

Teams will present their model to a panel of one or more judges.

Station 4 counts as 50% of a team's total score.



Regional Tournament Presentation Concepts:

- ☐ Groundwater recharge from precipitation
- ☐ Groundwater recharge from surface water
- ☐ Groundwater discharge to surface water
- ☐ Water table
- ☐ Saturated zone
- ☐ Unsaturated zone
- ☐ Pore space
- ☐ Impact a well has on groundwater quantity
- ☐ Impact a well has on surface water
- ☐ Importance of well siting (location)
- ☐ Importance of well closure (abandonment)
- ☐ Infiltration
- ☐ Groundwater as a part of the hydrologic cycle.
- ☐ Unconfined aquifer

When presenting the concepts students should be able to do the following:

Verbally define _____.

Clearly explain _____.

Point out or manipulate their model to clearly show _____.

State Tournament Presentation Concepts: *All of the regional tournament concepts listed above with the addition of the following concepts.*

- ☐ Potential groundwater contamination source(s) produced by human activities
- ☐ Naturally occurring groundwater contamination source(s)
- ☐ Movement of a contaminant in groundwater
- ☐ Impact a well has on groundwater quality
- ☐ Safe yield (aka sustainable yield)
- ☐ Confining layer/confined aquifer
- ☐ Contamination plume
- ☐ Area of influence/cone of depression
- ☐ Impermeable layer
- ☐ Overwithdrawl
- ☐ Leachate
- ☐ Nonpoint source pollution
- ☐ Point source pollution

National Tournament Presentation Concepts: *All of the regional and state tournament concepts listed above with the addition of the following concepts.*

- ☐ Impact contaminant sources have on humans and the environment
- ☐ Porosity (in at least two different materials and quantify difference)
- ☐ Permeability (in at least two different materials and quantify difference)
- ☐ Artesian aquifer, artesian well
- ☐ Remediation techniques (simulate technique and show reduction of contamination)
- ☐ The Wellhead Protection Area
- ☐ A Best Management Practice
- ☐ Groundwater under the direct influence of surface water
- ☐ Salt water intrusion
- ☐ Subsidence/Sink holes

Station 4: Sample Judge Worksheet

Station 4: Model Presentation
(Judge Worksheet)

Student's Names: Jack Q., Jill Z.

School: Smith Middle Team Number: 00

Judge Name: Jon Doe

INSTRUCTIONS TO JUDGES
1. Circle point values. 2. Add total. 3. Compare results to fellow judge(s) if more than one judge is evaluating a single team. 4. Attach team notes to worksheet. 5. Turn in to event supervisor.

Concept	Explain/Define	Demo/Point out	Total
Connection between surface water and groundwater	(1) *Explain connection by giving an example*	(1-2) *1 pt. recharge to groundwater 1 pt. discharge from groundwater*	2
Porosity	(1)	1-(2) *1 pt show porosity in 2 different materials, 1 pt quantify porosity difference*	3
Permeability	(1)	~~2~~ *Demonstrate permeability difference in 2 materials*	1
Importance of well siting	~~1~~	~~1~~	0
Importance of well closure	~~1~~	(1)	1
Impact to surface water bodies from a well	(1)	(1) *Show impact to surface water bo*	
Movement of a contaminant in groundwater	(1) Give specific example of contaminant	(1-2) *1 pt show contaminant move 1 pt pump contaminant fron*	
Remediation	~~1-2~~ *1 pt. define 1 pt. give specific example of real technique*	~~1-2~~ *1 pt demonstrate techniq 1 pt if clearly show contaminant*	
Sustainable (safe) yield from an aquifer	~~1-2~~ *1 pt define 1 pt state factor affecting sustainable (safe) yield*	~~1~~ *Show simultaneous recharge discharge from aquifer*	
Total Demonstration Points			

NOTES

Wrong definition of well siting, closure.

Station 4 Judge Worksheet

Event supervisors should create a worksheet that judges can use to record scores while judging at Station 4.

This format is particularly helpful to judges by defining specifically what points are awarded for. Keep your worksheet easy to read at a glance. Leave a space for judges to make to comments.

This worksheet should not be shared directly with students. It will be retained with the team score sheet/notes and will be turned in to tournament officials.

Planning Checklist

Planning Checklist

Lists will help keep you organized. Use this list to keep you on track while planning for a tournament.

DISCUSS WITH THE TOURNAMENT DIRECTOR:

- ☐ Date, time, and place of the tournament
- ☐ Number of teams expected to compete
- ☐ Awesome Aquifers facility requirements
  - 1-2 large, non-carpeted rooms (i.e. laboratory space)
  - Access to water
  - Large trash receptacle with extra trash bags
  - Paper towels for clean up
  - Plastic drop cloths or table covers
  - Model drop-off space (optional)
  - Availability of janitorial services
- ☐ Tournament schedule
- ☐ Tournament specific rules and score reporting procedure
- ☐ Availability of volunteers
- ☐ Communication with coaches/teams prior to the tournament

SCHEDULING:

- ☐ Decide how to rotate teams through all 4 stations (see pages 20-21 for sample formats)
- ☐ Create sign up sheets or assign students to times if needed , then notify coaches and students of altered scheduling arrangements (consult with tournament director on ways do this)

JUDGES:

- ☐ Determine the number of judges you will need (based upon number of teams and schedule format)
- ☐ Recruit judges—give them copies of rules, worksheet and judge tips
- ☐ Review Awesome Aquifers rules and worksheet with judges before tournament
- ☐ Encourage judges to build and test their own model aquifers in advance

OTHER VOLUNTEERS:

- ☐ Recruit 1-3 additional volunteers (pages 4-5) to assist the event supervisor with the following tasks. Note: multiple tasks can be performed by the same person.
  - Team check-in
  - Keep time

Checklist (cont.)

- Give directions to teams
- Grade tests from Station 1 and 2
- Tally scores, break all ties
- Double-check scores, turn in to tournament officials

TESTS AND FORMS TO CREATE IN ADVANCE:

- ☐ Test for Station 1
- ☐ Test for Station 2; secure multiple copies of journals, maps, models, and other resources to be used with this test
- ☐ Answer key for Station 1 and Station 2 tests
- ☐ Concept list for Station 3
- ☐ Judge worksheet (correlated with Station 3 concept list)
- ☐ Team score sheet
- ☐ Photocopy all documents listed above, be sure to make a few extra copies.

PACKING LIST FOR DAY OF TOURNAMENT:

- ☐ Copies of Station 1 test, Station 2 test, Station 2 resources, Answer keys, Station 3 concept lists, Judge worksheets, team score sheets, official rules
- ☐ Copies of the student evaluation (page 22)
- ☐ Copies of the judge evaluation (page 23)
- ☐ Jugs or pitchers to fill with water (place at Station 3)
- ☐ Scratch paper (place at Station 3)
- ☐ Stopwatch, kitchen timer, etc.
- ☐ Clipboards for judges and volunteers
- ☐ Pencils, erasers, pens
- ☐ Stapler and extra staples
- ☐ Paper clips and tape
- ☐ Paper towels, trash bags, disposable table cloths, etc.
- ☐ Snacks and drinks for your volunteers (might be provided by the tournament director or hosts)

AFTER EVENT:

- ☐ Thank judges and volunteers
- ☐ Submit evaluations to The Groundwater Foundation

Congratulations

You are on your way to a well planned event. Remember to have fun and enjoy the experience!

Need More Help?

If you are an event supervisor or judge and have questions about Awesome Aquifers or about making it part of your event, please contact The Groundwater Foundation at joltman@groundwater.org or 1-800-858-4844.

Tips for Event Supervisors

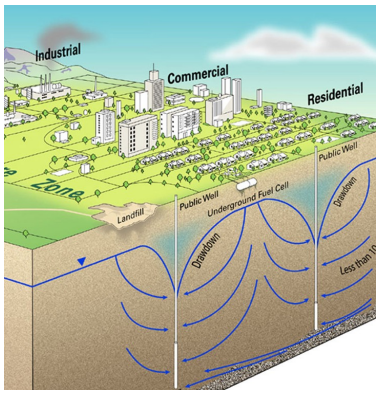
- Awesome Aquifers requires at least one person who is knowledgeable about groundwater. It is helpful, but not a requirement, that the event supervisor have a background in groundwater. Despite their background knowledge, event supervisors are encouraged to ask another groundwater professional to review testing materials.
- Depending on the size of your tournament, one person may be able to handle the event. For a larger tournament, you may need different individuals to serve as event supervisors, judges, test proctors, room monitors, and timers.
- Scheduling: The event requires students to complete four 10-minute stations, all of which can be in use at one time. More than one team can be at a station at one time provided there is a judge for every team at Station 4. There will need to be a little space between each Station to allow students to work without disturbing each other and to help keep the "surprise" elements of the competition a surprise. If the tournament requires lots of teams to be judged in a short amount of time, multiple identical stations can be used as long as sufficient judges are available to have a judge for each team at Station 4. Two scheduling strategies follow on pages 20-21).
- Teams do not need to complete the stations in numerical order. However, teams will need the opportunity to build their model at Station 3 before presenting it to judges at Station 4.
- Consider having judges work in pairs. This strategy increases the consistency of judging but also doubles the number of judges needed.
- This can be a messy event; request a science laboratory classroom or other non-carpeted space.
- Provide water in jugs (recycled milk cartons/soda bottles) or easy access to water (lab classroom) at Station 3 and Station 4.
- Provide the proper materials (trash cans, paper towels, and water) at Station 3 and 4 so students can clean up after themselves.
- It's helpful, but not required to offer space for teams to store their materials prior to the competition. Teams should be notified that this storage opportunity is not considered "impound," meaning that their supplies will be left unguarded and unattended. Teams are leaving their supplies at their own risk.
- Notify teams that they are responsible for collecting and removing all their materials from the room at the end of competition. They should recycle/dispose of their models on their own. Do not allow them to leave this clean-up chore for you.
- Sample tests are available to state tournament directors from The Groundwater Foundation. Contact joltman@groundwater.org or call 1-800-858-4844.
- Students will not know what concepts they will need to demonstrate with their aquifers until the competition begins. Because of this "surprise" element, you probably won't want to have your event open for observation. If the structure of your event allows for observation by parents and coaches, consider reasonable rules such as asking visitors not to speak with participating teams or be within 10 feet of Station 4.
- Check with your tournament director on overall tournament rules. For example, most tournaments have a ban on cell phones to discourage cheating. Seek advice from your tournament director on how to deal with issues like this.

Tips for Volunteers

- As teams arrive, check them off the schedule (as provided by the event supervisor/ tournament director). Assign teams to a designated station.
- Distribute one team score sheet to each team. Ask them to fill out the top portion with their names, school, and team number (Note: not all tournaments assign numbers to teams).
- Make sure each team has at least one pencil. Have pencils available for loan.
- Make sure each station has the required items. Tests at Stations 1 and 2, paper towels and water at Station 3, concept list and scratch paper at Station 3, multiple copies of judge worksheet at Station 4.
- Observe students to make sure they are not working on any task outside of the 10 minute working period. Make sure that all pencils are down and the test questions/ concept list is collected or hidden from view inside a closed folder, etc, during down time. Students should not be unpacking building materials at this time either (however, they can use this time to clean up after building).
- Make sure that no copies of the tests, score sheets, concept lists, notes or resources leave the room.
- Do not answer substantive questions about building models, demonstrating concepts, etc. It's fine to answer materials and supplies questions such as "Can I get more water?" or "Do you have paper towels?"
- Official time keeper. Use a kitchen timer or stop watch to measure 10 minute increments. Alert the entire room with interval warnings in a count down format (i.e. "5 minutes left," "1 minute left," etc).
- Remind teams to take their models and extra materials with them either after they've been judged, or by the close of the event.
- Clean up stations as teams finish using them. If a team can help with the cleanup, great!
- Grade tests from Station 1 and 2 using answer key provided by event supervisor. Award no partial points.
- Be flexible. If a team or teammate is late, cycle them into the competition when possible.
- Watch for cheating: Students are not to leave the room during the competition. Students should not be using a cell phone (making calls, texting, photographing, etc). Students should not have any pre-written notes or bring any reference materials with them. Check with the event supervisor for other rule violations.
- Help collect score sheets and staple all of a team's paper together when they've finished competition.
- Distribute and collect evaluations from students and judges. Mail completed evaluations to Awesome Aquifers, c/o The Groundwater Foundation, PO Box 22558, Lincoln, NE 68542-2558.

Volunteer Duties

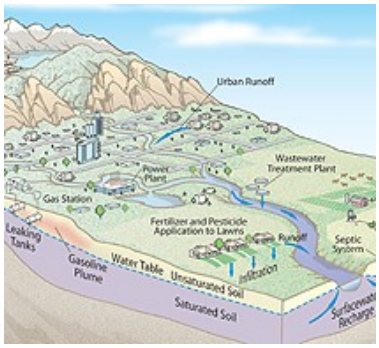
In a nutshell, extra volunteers will help the event supervisor ensure that the room where students are testing, assembling models, and being judged is run smoothly.



Tips for Judging and Scoring

Need More Help?

If you are an event supervisor or judge and have questions about Awesome Aquifers, please contact The Groundwater Foundation at awesomeaquifers@groundwater.org or 1-800-858-4844.



GENERAL TIPS:

- Before judging begins, review the rules and score sheet carefully. Be sure you're familiar with all terms on the rules and score sheet. Discuss them with your fellow judges to help assure judging consistency.
- If possible, practice judging one or two models before a tournament begins. If you've never built a model aquifer, build one prior to the event if possible. If time permits, have a brief judges meeting after judging the first couple models to compare notes and see if judges have questions and are judging models consistently.
- If there are enough volunteers available, judge in teams of two and compare notes to determine a team's final score. When comparing notes, judges should step away from the students to discuss their scores in private. Score results are not to be shared with the students.
- Judges should fill out top portion of a worksheet with team information before the 10 minutes begin.
- Students may explain and/or demonstrate the required concepts in any order. The same demonstration may cover more than one concept, but students must explicitly tell you so.
- Students may create notes at Station 3 to use during their presentation at Station 4. Collect the notes from the students before they leave Station 4 and attach them to the judge worksheet (see sample judge worksheet on page 13).
- Sometimes coaches will ask clarification questions in regards to the official rules. These questions and their responses will be posted on the Science Olympiad website at www.soinc.org and The Groundwater Foundation's Science Olympiad pages at www.groundwater.org.

CONTAINERS AND MATERIALS:

- Official rules state that models can be no larger than 3 liters in total volume. If models are obviously larger than the suggested size it will be up to the judge(s) and event supervisor to determine if the model is in violation of this rule. Determination that the model exceeds 3 liters should be done prior to starting the 10-minute judging. The team MUST be notified of their violation immediately, describe the violation in the notes section on the judge worksheet, then allow the team to begin their 10-minute presentation. Any rule violation will dramatically affect their overall score, but will not disqualify them from completing the event.
- Students are not allowed to use commercially produced flow models, even if they add their own materials. (Refer to the bullet above on protocol dealing with rule violations.) Students may construct original containers if they wish, although they are discouraged from doing so. Some students are able to construct very professional-looking models, so you may need to ask a team about the origin of their model if you have any suspicions.
- Containers must be empty when students arrive at Station 3. Models that show up to the competition already built are in violation of the rules.
- The list of materials contained in the rules is a suggested list of materials that should allow students to demonstrate all required concepts. With the exception of motorized tools and hazardous chemicals, students may add to the list if they like. Students are not

Tips for Judging and Scoring

to be penalized if they fail to bring materials on the list; their penalty will come in trying to build models without the correct materials. It is permissible if teams loan each other materials.

- Set high standards—be a fairly tough judge. Many teams will likely be very well prepared, and you will need to be able to distinguish among them. If you're too lenient, it will make it harder to determine the medal-winning teams.
- A volunteer will keep time and provide verbal five-minute and one-minute warnings to the entire room.
- The ten-minute time limit is to be strictly enforced at all stations, including Station 3 where students build their aquifers. It is considered a violation of the rules for any team who fails to stop working at the conclusion of the 10-minutes. At Station 4, simply stop the student's demonstration even if they are not done. Teams will not be penalized if a judge has to stop a team in mid-sentence or thought.
- Do not interrupt students during their presentations.
- If a team finishes its demonstration early, please ask students questions to clarify their answers or prompt them on a concept they may have overlooked. Students have a tendency to just explain and forget to demonstrate. Feel free to say something such as, "Can you demonstrate what you're telling me?" If you still have time, visit with the students about their models, what they've learned, and how you use your groundwater knowledge in your work.

SCORING:

- The event supervisor will create all score sheets. Half of a team's total points come from Station 4, and the other half from Stations 1 and 2 combined.
- As students explain/define and demonstrate/point out groundwater concepts, judges can circle the number that corresponds to the points they receive, and write totals in the totals column on the judge worksheet.
- No partial points allowed! Students either correctly defined/clearly demonstrated the concept or they did not.
- All ties must be broken! The event supervisor is responsible for breaking ties; refer to the event rules for tie-breaking options.
- Do not tell students their scores or show them their score sheets.
- If you determine a team is in violation of the event rules for any reason, you must inform the team before they leave the testing area how they have violated the rules. A rule violation is taken very seriously and may be contested by the team and their coaches if they feel your determination is unfair. Be sure to take thorough notes on the team score sheet/judge worksheet explaining why you decided the team is in violation. A team with a rule violation will be scored below all other teams that are within the rules. See your tournament director for scoring instructions.

Scoring Basics

1. Award no partial points. Either a student knows it or they don't.
2. Look for scientific accuracy in their model explanations; look for clarity in their visual demonstrations.
3. Attractive models, expensive materials and cleaver story lines do not earn extra points.
4. Do not share scores with students; do not tell them if they are right or wrong.
5. If a team has violated the rules, immediately tell them why, record the violation in writing, then allow the team to continue to compete.
6. After every team has competed but before turning scores in to tournament officials, break all ties with the predetermined tie-breaking method.

View more photos online at www.groundwater.org.

Scheduling Example 1: Rotation Strategy

10 min

Teams will rotate every 10 minutes to a new station. Using 4 tracks per station, 12 teams can compete in less than 50 minutes (max 16 teams* in 20 min) with a minimum of 4 judges. Do not place any teams at Station 4 during this initial 10 minutes. When possible, stagger stations and assign 1 team per table to deter cheating. Note: Scale the number of tracks offered to number of teams competing. 12 teams are shown here competing in 4 tracks.

Station 1 Team A Team B	Station 3 Team G Team H
Station2 Team C Team D	Station 1 Team I Team J
Station 3 Team E Team F	Station 2 Team K Team L
Station 4 (2 judges min) *open* *open*	Station 4 (2 judges min) *open* *open*

This sample layout places multiple teams at a single, large table. Most laboratory classrooms are set up with just a few large tables. Consider staggering the proximity of stations.

10 min

Give students a minute (3 minutes at most) to collect their items and move to the next station. If space allows, have all teams move in the same direction (South, in this example). Remember, teams do not have to complete Stations 1 through 3 in numerical order. Optional, up to 4 additional teams (1 per track) can rotate in if needed. *Refer to diagram below to see how a *new team* is incorporated in the rotation cycle.

Station 1 *open* *New team**	Station 3 Team I Team J
Station2 Team A Team B	Station 1 Team K Team L
Station 3 Team C Team D	Station 2 *open* *open*
Station 4 (2 judges min) Team E Team F	Station 4 (2 judges min) Team G Team H

10 min

Give students 1-3 minutes to collect their items and move to the next station (leaving the test at the table). Idea: help students understand the rotation by providing small signs or place cards at each station to identify it by number and to tell the team where to move next.

Station 1 Team E Team F	Station 3 Team K Team L
Station2 *open* *New team**	Station 1 *open* *open*
Station 3 Team A Team B	Station 2 Team G Team H
Station 4 (2 judges min) Team C Team D	Station 4 (2 judges min) Team I Team J

10 min

Give students 1-3 minutes to collect their items and move to the next station. This marks the final rotation for the original 12 teams. If any additional teams* were rotated in during the second 10 minute block they will require one more 10 minute cycle to finish.

Station 1 Team C Team D	Station 3 *open* *open*
Station2 Team E Team F	Station 1 Team G Team H
Station 3 *open* *New team**	Station 2 Team I Team J
Station 4 (2 judges min) Team A Team B	Station 4 (2 judges min) Team K Team L

The rotation strategy is the most widely used format at state and national tournaments.

Scheduling Example 2: Block Strategy

10 min

In this strategy, teams do not move to different stations. Instead, the stations are brought to them. The block strategy allows for 12 teams to compete in 50 minutes with a minimum of 4 judges. During the first 10 minute block of competition, all teams will build their model (complete Station 3). Once 10 minutes have lapsed, all construction materials are to be cleaned up and put away, presentation notes must be collected at this time as well. Recruit 1-3 volunteers to assist with this.

Team A	Team B	Team C	Team D	<build
Team E	Team F	Team G	Team H	<build
Team I	Team J	Team K	Team L	<build

This sample layout places teams at individual desks. If your space has a few, larger tables, it is permissible to combine multiple teams at each table. Most laboratory classrooms are set up with just a few large tables.

10 min

During the next 10 minute block 1/3 of the teams will be judged (teams A, B, C, and D in this example), 1/3 will be taking the test for Station 1 (E, F, G, and H), and 1/3 will be taking the test for Station 2 (I, J, K, and L). Before beginning the 10 minute timer, pass out tests (face down or inside a folder), distribute resources to teams taking the Station 2 test, and return presentation notes to the teams about to be judged. When time is up, collect all tests, resources, and student notes.

Team A	Team B	Team C	Team D	<judge
Team E	Team F	Team G	Team H	<test 1
Team I	Team J	Team K	Team L	<build

10 min

Now teams A, B, C, and D will take the resource test for Station 2; teams E, F, G, and H will be judged (Station 4); while teams I, J, K, and L take the Station 1 test. Again once time is called immediately collect all tests, resources, and student notes.

Team A	Team B	Team C	Team D	<test 2
Team E	Team F	Team G	Team H	<judge
Team I	Team J	Team K	Team L	<test 1

10 min

For the final 10 minute block teams A, B,C, and D will take the Station 1 test; teams E, F,G, and H will take the Station 2 test; while teams I, J, K, and L are being judged. At the end of this time block all teams will have completed all 4 stations.

Team A	Team B	Team C	Team D	<test 1
Team E	Team F	Team G	Team H	<test 2
Team I	Team J	Team K	Team L	<judge

Awesome Aquifers Student Evaluation

1. Did you enjoy Awesome Aquifers? _____

2. Would you participate in Awesome Aquifers again? □ Yes □ No

   If no, why? _____

3. How much did you know about groundwater before starting Awesome Aquifers? _____

   _____

4. What did you learn from this event? _____

5. Where did you get your information? _____

6. Did this event influence you to conserve or protect groundwater? _____

7. Do you have any suggestions to improve the event or the rules? _____

Awesome Aquifers Student Evaluation

1. Did you enjoy Awesome Aquifers? _____

2. Would you participate in Awesome Aquifers again? □ Yes □ No

   If no, why? _____

3. How much did you know about groundwater before starting Awesome Aquifers? _____

   _____

4. What did you learn from this event? _____

5. Where did you get your information? _____

6. Did this event influence you to conserve or protect groundwater? _____

7. Do you have any suggestions to improve the event or the rules? _____

2007 AAB Event Guide

Awesome Aquifers Judge Evaluation

1. State tournament took place in: _____. Level of tournament: ☐ invitational ☐ local ☐ regional ☐ state ☐ national

2. Did you enjoy your experience as a judge? Why or why not. _____

   _____

3. What suggestions do you have to improve Awesome Aquifers? _____

   _____

4. Please tell us a few things you observed or learned during the tournament. For example: How well-prepared were students? How would you summarize the scores? Did a student, coach or parent tell you something interesting about Awesome Aquifers?

   _____

5. What was your biggest challenge as a judge? _____

   _____

Awesome Aquifers Judge Evaluation

1. State tournament took place in: _____. Level of tournament: ☐ invitational ☐ local ☐ regional ☐ state ☐ national

2. Did you enjoy your experience as a judge? Why or why not. _____

   _____

3. What suggestions do you have to improve Awesome Aquifers? _____

   _____

4. Please tell us a few things you observed or learned during the tournament. For example: How well-prepared were students? How would you summarize the scores? Did a student, coach or parent tell you something interesting about Awesome Aquifers?

   _____

5. What was your biggest challenge as a judge? _____

   _____

2007 AAB Event Guide

Glossary: Terms to Know

Aeration zone: The zone immediately below the land surface where the pores contain both water and air, but are not totally saturated with water. Plant roots can capture the moisture passing through this zone, but it cannot provide water for wells. Also known as the unsaturated zone.

Aquifer: An underground geological formation able to store and yield water.

Cone of depression: The zone around a well in an unconfined aquifer that is normally saturated, but becomes unsaturated as a well is pumped, leaving an area where the water table dips down to form a cone shape. The shape of the cone is influenced by porosity and the water yield or pumping rate of the well.

Confining layer: Geologic material with little or no permeability or hydraulic conductivity. Water does not pass through this layer or the rate of movement is extremely slow.

Depletion: The loss of water from surface water reservoirs or groundwater aquifers at a rate greater than that of recharge.

Discharge: An outflow of water from a stream, pipe, groundwater aquifer, or watershed; the opposite of recharge.

Drawdown: A lowering of the groundwater level caused by pumping.

Flow rate: The time required for a volume of groundwater to move between points. Typically groundwater moves very slowly—sometimes only inches per year.

Groundwater: Water found in the spaces between soil particles and cracks in rocks underground (located in the saturation zone). Groundwater is a natural resource that is used for drinking, recreation, industry, and growing crops.

Hydrologic cycle: (also known as the water cycle) The paths water takes through its various states--vapor, liquid, solid--as it moves throughout the oceans, atmosphere, groundwater, streams, etc.

Impermeable layer: A layer of material (such as clay) in an aquifer through which water does not pass.

Infiltration: Flow of water from the land surface into the subsurface.

Infiltration rate: The quantity of water that enters the soil surface in a specified time interval. Often expressed in volume of water per unit of soil surface area per unit of time.

Monitoring well: A non-pumping well, generally of small diameter, that is used to measure the elevation of a water table or water quality.

Overwithdrawal: Withdrawal of groundwater over a period of time that exceeds the recharge rate of the supply aquifer. Also referred to as overdraft or mining the aquifer.

Permeable/Permeability: Capable of transmitting water (porous rock, sediment, or soil); the rate at which water moves through rocks or soil.

Permeable layer: A layer of porous material (rock, soil, unconsolidated sediment); in an aquifer, the layer through which water freely passes as it moves through the ground.

Plume: In groundwater a plume is an underground pattern of contaminant concentrations created by the movement of groundwater beneath a contaminant source. Contaminants spread mostly laterally in the direction of groundwater movement. The source site has the highest concentration, and the concentration decreases away from the source.

Glossary (cont.)

Pore space: Openings between geologic material found underground. Also referred to as void space or interstices.

Porosity: The ratio of the volume of void or air spaces in a rock or sediment to the total volume of the rock or sediment. The capacity of rock or soil to hold water varies with the material. For example, saturated sand contains about 20% water; gravel, 25%; and clay, 48%.

Recharge: Water added to an aquifer. For example, when rainwater seeps into the ground. Recharge may occur artificially through injection wells or by spreading water over groundwater reservoirs.

Recharge rate: The quantity of water per unit of time that replenishes or refills an aquifer.

Recharge zone or area: An area where permeable soil or rock allows water to seep into the ground to replenish an aquifer.

Remediation: Containment, treatment or removal of contaminated groundwater. May also include containment, treatment or removal of contaminated soil above the water table.

Residence time: Period of time that groundwater remains in an aquifer.

Safe yield: The annual amount of water that can be taken from a source of supply over a period of years without depleting that source beyond its ability to be replenished naturally in "wet years." Also called sustainable yield.

Salt water intrusion: Process by which an aquifer is overdrafted creating a flow imbalance within an area that results in salt water encroaching into fresh water supply.

Saturation zone: The portion below the earth's surface that is saturated with water is called the zone of saturation. The upper surface of this zone, open to atmospheric pressure, is known as the water table.

Subsidence: A depression of the land surface as a result of groundwater being pumped. Cracks and fissures can appear in the lnd. Subsidence is virtually an irreversible process.

Surface water: Water above the surface of the land, including lakes, rivers, streams, ponds, floodwater, and runoff.

Water table: The top of an unconfined aquifer; indicates the level below which soil and rock are saturated with water. The upper surface of the saturation zone.

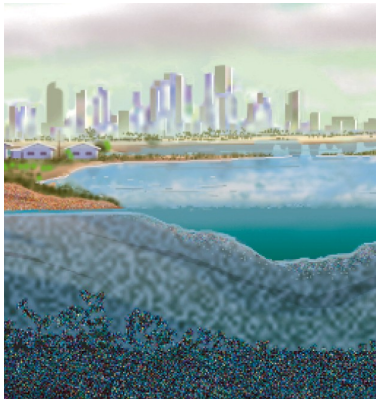
Well: A bored, drilled or driven shaft, or a dug hole whose depth is greater than the largest surface dimension and whose purpose is to reach underground water supplies to inject, extract or monitor water.

Well closure: The process of sealing a well that is no longer being used to prevent groundwater contamination and harm to people and animals.

Well siting: Location of a well placed to best protect water quality, access adequate water quantity, and allow for inspection and maintenance of the well.

Wellhead protection area: A protected surface and subsurface zone surrounding a well or well field supplying a public water system to keep contaminants from reaching the well water.

Withdrawal: Water removed from a surface or groundwater source for use.



Learn more terminology online at www.groundwater.org.

Notes

Science Olympiad

Science Olympiad is a nonprofit organization devoted to improving the quality of science education, increasing student interest in science and providing recognition for outstanding achievement in science education by both students and teachers.

These goals are accomplished through classroom activities, research, training workshops and the encouragement of intramural, district, regional, state and national tournaments.

Science Olympiad tournaments are academic competitions that consist of a series of individual and team events which students prepare for during the school year. These competitions are balanced among the various science disciplines of biology, earth science, chemistry, physics, computers and technology.

For more information about Science Olympiad, visit their official website at www.soinc.org.

Acknowledgements

The Awesome Aquifers Event Guide was produced and published by The Groundwater Foundation.

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