

#3. Water Cycles & Watersheds

Summary: In this module you will learn about the water cycle, global distribution of water resources, and basic watershed principles.

Goals: By the end of this module you will be able to describe your watershed at multiple scales, identify the major sources of water in your region, and discuss the ways in which surface water and groundwater are interconnected.

Required readings:

Water Cycle (General) -- https://cnx.org/contents/F0Hv_Zza@45.1:yeVQResF@5/Water-Cycle-and-Fresh-Water-Supply

Watersheds (General) – <https://cfpub.epa.gov/watertrain/pdf/modules/WatershedEcology.pdf>

More detailed information -

https://www3.epa.gov/owow/climate_change_and_water_resources/story_html5.html
(complete the entire module on-line, allow one hour, complete in one session). The transcript for this module is available here if technology constraints do not allow for online participation:
https://www.epa.gov/sites/production/files/2016-01/documents/understanding_climate_change_impacts_on_water_resources_transcript.pdf

Supplemental Content (Instructor can review in class or assign directly):

https://www.usgs.gov/special-topic/water-science-school/science/water-cycle-adults-and-advanced-students?qt-science_center_objects=0#qt-science_center_objects

<https://www.usgs.gov/special-topic/water-science-school/science/surface-water>

<https://www.usgs.gov/special-topic/water-science-school/science/groundwater>

Audio recording, NPR story of J.W. Powell's summary of Water in the West:

<https://www.npr.org/templates/story/story.php?storyId=1413174> map to accompany the story: <https://i.pinimg.com/originals/3d/9c/35/3d9c35052a5e9d5774e91437ba50d698.jpg>

Key Vocabulary: water cycle, runoff, transpiration, precipitation, infiltration, discharge, evaporation, storage, sublimation, condensation, drainage basin, recharge, water table, aquifer, cone of depression, lotic, lentic, watershed

Assessment Tools:

Watershed Quiz: Note that pages 33 – 37 at the end of the assigned reading for the Watershed topic is a “self-assessment quiz”. The answer key is on page 38.

<https://cfpub.epa.gov/watertrain/pdf/modules/WatershedEcology.pdf>

Water Cycle Discussion Questions (can be used in classroom or for on-line discussion board):

Review Questions

Question:

What is the water cycle and why is it important to fresh water resources?

Question:

What are the relative merits of using surface water vs. groundwater as a water resource?

Question:

What should society learn from the case history of the Aral Sea?

Question:

Why is society facing a crisis involving water supply and how can we solve it?

Source: https://cnx.org/contents/F0Hv_Zza@45.1:yeVQResF@5/Water-Cycle-and-Fresh-Water-Supply (the assigned reading)

Additional discussion questions:

- What is the source of the drinking water at your home? At our college? (be specific).
- Do we receive enough atmospheric precipitation in our region to replace human consumptive use? Does our precipitation arrive at the time of greatest use? What are the biggest consumptive uses in our area?
- Where are the largest reserves of water on the planet? What are some of the major challenges of accessing them for human consumptive use?

Water Cycle Assignment: Diagram a generalized hydrologic cycle for the watershed of a 3rd to 5th order stream/river in your location / region. Label all water sources, sinks, and losses (including stream discharge). Include a label to name all of the downstream waterbodies into which the water in this stream will eventually flow. The concept of stream order was introduced in the assigned reading on watersheds. Additionally, the following resource reviews the concept of stream order:

<http://www.cotf.edu/ete/modules/waterq3/wqassess4b.html>

It is recommended that you use USGS's mapping services to delineate the geographic area that you will use to complete this water cycle assignment. Start with the national map (nationalmap.gov), open up the National Map Viewer, and on the "Layer List" tab, turn on both the National Hydrography Dataset and Watershed Boundary Dataset layers. You can zoom the map to identify 1st, 2nd, 3rd, and larger order streams, identify how those fall within delineated hydrologic units and watersheds, etc. and then navigate downstream to follow the water. Note: training videos are available to provide more instruction on how to access and use the National Map. <https://www.usgs.gov/core-science-systems/ngp/tnm-delivery/training>

Module 3 Lab Activity – Darcy’s Law & Groundwater Flow

View the background video. <https://www.youtube.com/watch?v=mb8clQdvrvo>

Read the background information: https://serc.carleton.edu/s/integrate/water_science_society/926

Complete the on-line lab exercise on Darcy’s Law found at this website. (Download the assignment worksheet and the Data file to complete the lab activity.)

https://serc.carleton.edu/s/integrate/water_science_society/1031

Alternate Module 3 Lab Activity – Seasonal Patterns in Groundwater Levels

Explore the types of data available on national groundwater resources at the USGS’s National Water Information Website (NWIS): <https://waterdata.usgs.gov/usa/nwis/gw/>

From this site, obtain groundwater level data for a well located in your community (or county) for which there is at least a 5-year continuous record of water level. Prepare a lab report that addresses the following null hypothesis: *Water level remains constant in my local well.*

Follow the IMRAD method to prepare your lab report. This resource shows how to write a good lab report with IMRAD: <https://writingcenter.unc.edu/tips-and-tools/scientific-reports/> Note: this resource also shows the correct way to cite reference materials.