

# Aquatics: Course Outline

- I. Natural History of Aquatic Resources in Iowa
  - A. Historical Perspective of Iowa's Aquatic Resources
    - 1. Glaciers
    - 2. Surface Water
      - a. Streams and Rivers
        - i. Oxbows
        - ii. Backwaters
      - b. Natural Lakes
      - c. Reservoirs / Constructed Lakes
      - d. Surface Mines & Pits
      - e. Ponds
      - f. Springs
      - g. Wetlands / Shallow Lakes
    - 3. Groundwater
      - a. Aquifers
- II. Freshwater Ecology
  - A. Abiotic Component
  - B. Biotic Component
  - C. Water Cycle
  - D. Surface Water
    - 1. Lentic
    - 2. Wetland
    - 3. Lotic
  - E. Groundwater
  - F. Identification
    - 1. Using Dichotomous Keys
    - 2. Using Field Guides
    - 3. Animals
    - 4. Plants
    - 5. Invasive Species
- III. Water Management
  - A. Economics
    - 1. Humans
      - a. Water Supply
      - b. Wastewater
    - 2. Recreation
      - a. Sustainable Yield
      - b. Harvest
    - 3. Commerce
    - 4. Industry
  - B. Watershed (HUC's)
  - C. Agencies
    - 1. EPA

2. FEMA
  3. DNR
  4. USCOE
  5. USFWS
- D. Water Quality
1. Physical
  2. Biological
  3. Chemical
  4. Pollutants
    - a. Point Source
    - b. Non-Point Source
- E. Classification of Water Resources
1. Class A
  2. Class B
  3. Class C
  4. General Use
- F. Sampling Equipment
1. Vertebrates
  2. Invertebrates
  3. Water Quality (chemical/physical parameters)
- IV. Careers Associated with Aquatics
- A. Governmental
1. Local
  2. State
  3. Federal
- B. Private
- V. Appendix
- A. Terms
- B. Resources
- C. Curriculum Standards
1. Agriculture
  2. Science

# Aquatic: Terms

acid rain  
acre-foot  
aerobic  
algae  
algal bloom  
alkaline  
anadromous fish  
anaerobic  
aquaculture  
aquatic  
aquatic macrophytes  
aquifer  
bacteria  
benthic  
benthos  
best management practice - BMP  
bioaccumulation  
biological oxygen demand - BOD  
biodegradation  
biodegradable  
blue-baby syndrome  
bog  
brackish water  
cation  
channelization  
cohesion  
coliform bacteria  
community  
compensation depth  
cone of depression  
confined aquifer  
contamination  
cubic foot per second - CFS  
current  
denitrification  
discharge  
dissolved oxygen  
dissolved solids  
diversion  
drainage area  
drainage basin  
drawdown  
ecosystem  
effluent  
emergent plants  
endangered species  
environment  
ephemeral stream  
epilimnion  
erosion  
*Escherichia coli* Bacteria (E-coli)  
estivation  
estuary  
eutrophic  
eutrophication  
evaporation  
evapo-transpiration  
fecal bacteria  
fecal coliform bacteria  
fen  
fertilizer  
filter feeder  
filtrate  
floating-leaf plant  
floodplain  
fluvial  
freshwater  
friable  
fry  
gaining stream  
glacial  
glacial drift  
ground water  
ground water recharge  
habitat  
hard water  
headwaters  
herbaceous  
herbicide  
hydric soil  
hydrologic cycle  
Hydrologic Unit Code - HUC  
hypolimnion  
infiltration  
impermeability  
indicator species  
inorganic  
insecticide

intermittent stream  
intolerant organism  
invertebrate  
irrigation  
Karst  
kettle  
kettle lake  
lacustrine  
lagoon  
leachate  
leaching  
lentic  
limnetic  
limnology  
littoral  
losing stream  
lotic  
marsh  
meanders  
mesophyte  
mesotrophic  
metalimnion  
micocytin  
midge  
monitoring  
nitrate  
nonpoint-source pollution  
nuisance species  
nutrient  
nymph  
oligatrophic  
organic  
organic detritus  
osmosis  
outwash  
oxbow  
palustrine wetlands  
parts per billion - PPB  
parts per million - PPM  
pathogen  
peat  
pelagic  
perched ground water  
percolation  
perennial stream  
permeability

pesticide  
PH  
phosphorus  
phytoplankton  
pioneer plant species  
plankton  
point-source pollution  
pollutant  
population  
potable water  
prairie pothole  
precipitation  
riffle  
riparian  
riparian zone  
riverine wetland  
runoff  
saturated zone  
secchi disk  
sediment  
sedimentation  
septic systems  
sessile  
siltation  
sinkhole  
soft water  
solute  
solution  
solvent  
spring  
stratification  
stratified drift  
submersed plant  
substrate  
summer kill  
surface runoff  
surface tension  
surface water  
suspended sediment  
sustainable yield  
swamp  
thermocline  
thermal pollution  
threatened species  
tile drain  
till

tolerant species  
total maximum daily load - TMDL  
transpiration  
turbidity  
turnover  
unconfined aquifer  
unsaturated zone  
useable water  
urban runoff  
vascular plant  
vernal pool  
viscosity  
wastewater  
watershed  
water table  
weather  
weathering  
wetlands  
winter kill  
withdrawal  
xerophyte  
zooplankton

# Aquatic: Resources

The following resources were suggested by the writers and reviewers. There are many additional resources available and many more being developed daily, especially via the web. Website resources contain lists of publications related to specific topics. Individual books or pamphlets from websites were not listed because of space. Please view these as a starting point and add others to the list as you develop your specific course objectives.

## Websites:

### Conservation Districts of Iowa

Conservation Districts of Iowa (CDI) is a nonprofit organization devoted to providing educational programs on the conservation of soil, water, and other natural resources. CDI coordinates Iowa's Envirothon program.

<http://www.cdiowa.org>

### Iowa Department of Agriculture and Land Stewardship

Information and publications related to Iowa's Agriculture and Conservation/Natural Resource issues and programs

<http://www.agriculture.state.ia.us/default.htm>

### Iowa Department of Natural Resources

Publications on conservation/natural resources including, Project Learning Tree, Project Wild, Project WILD *Aquatic*, and supplements to these programs which provide background information relative to wildlife and their management.

<http://www.iowadnr.gov>

### Iowa Geological Survey

Responsible for the collection, analysis and dissemination of information on Iowa's rivers, lakes, groundwater, and wetlands.

<http://www.igsb.uiowa.edu/>

### Iowa Lakes Information System

Provides a comprehensive access point for obtaining physical, chemical and biological information for Iowa's lakes

<http://limnology.ecob.iastate.edu/lakereport/>

### Iowa Rivers Information System

Provides a comprehensive access point for obtaining physical, chemical and biological information for Iowa's interior streams and rivers.

<http://maps.gis.iastate.edu/iris>

### IOWATER

Includes information on volunteer water quality monitoring (fact sheets, Benthic Key, Manuals, etc.)

<http://www.iowater.net/defaultExp.htm>

Iowa State University Extension Publications

Extensive publication list for all aspects of aquatic and fisheries management.

<http://www.extension.iastate.edu/pubs>

Natural Resources Conservation Service

Extensive publication list for wetland programs.

<http://www.nrcs.usda.gov/technical/land/pubs/>

U.S. EPA Office of Wetlands, Oceans, and Watersheds

Provides information on Oceans, Watersheds and Wetlands of the United States

<http://www.epa.gov/OWOW/>

**Books, CD's, Pamphlets:**

*Background Information on Iowa's Aquatic Resources.* IDNR,

<http://www.iowadnr.gov/education/backinfo.html>

*Biodiversity CD.* IDNR, Contains information about Iowa's Aquatic habitats and the types of organisms living in them. order from [AquaticEd\\_Info@dnr.iowa.gov](mailto:AquaticEd_Info@dnr.iowa.gov)

*Field Guides.* A variety of field guides, each with their own unique qualities, are available from many sources. It is important to know how to use a Field Guide to identify specimens.

*Iowa's Natural Heritage.* Iowa Academy of Science and Iowa Natural Heritage Foundation. 1982. Call Iowa Natural Heritage at 1-515-288-1846.

*Managing Our Natural Resources.* Camp, William G., etal. 2002. DELMAR, 4<sup>th</sup> ed.

<http://www.Agriscience.Delmar.com>

*Putting Together a Watershed Management Plan.* CTIC,

<http://www.ctic.purdue.edu/KYW/Brochures/PutTogether.html>

*Wildlife & Natural Resource Management.* Kevin H. Deal, DELMAR, 1998.

<http://www.Agriscience.Delmar.com>

# **Aquatics: Curriculum Standards and Benchmarks**

## **Agricultural Education Standards, Benchmarks, and Performance Indicators**

### **Agricultural Business, Supply & Service**

Standard AB-1: Understand problem-solving, analysis, and decision-making in agriculture.

#### Benchmarks

A. Analyze situation, use problem-solving approach and make appropriate decisions.

1. Compare the advantages and disadvantages of biological, chemical and cultural pest controls.

Standard AB-12: Understand basic technical skills and knowledge in the occupational area of agricultural business, supply and service.

#### Benchmark

L. Apply technical skills in a hands-on experiential setting in agriculture.

39. Read a soil classification map.

### **Agricultural Production**

Standard AP-10: Understand basic computational and informational technology.

#### Benchmark

J. Apply computational and informational technologies to analyze and solve mathematical problems.

1. Evaluate and demonstrate use of current technology in land surveying and measuring.
2. Utilize digitized soil surveys to establish a soil sampling method and formulate a nutrient.

Standard AP-12: Understand basic technical skills and knowledge in the occupational area of production agriculture.

#### Benchmark

K. Apply technical skills in a hands-on experiential setting in agriculture.

4. Analyze the environmental effect that agricultural stewardship may have on surface and ground water, wildlife, soil, air, and people.
19. Explain soil and water conservation practices and their part in federal program compliance.



21. Identify and demonstrate plant growth and reproduction.
22. Identify and select biological and chemical pest controls for agronomic production.
34. Use the survey plat of township, range and section to describe an area.

## **Horticulture**

Standard H-1: Understand problem solving, analysis, and decision-making in agriculture.

### Benchmarks

A. Analyze situation, use problem-solving approach and make appropriate decisions.

2. Use observational techniques to identify healthy, quality plants.
3. Interpret data of soil sample analysis.
5. Choose an appropriate plant for a specific location in a home or business.
6. Choose plants of appropriate mature size, shape, texture, and function for a given site.

Standard H-8: Understand the concept of adapting to change in agriculture.

### Benchmark

H. Develop strategies to effectively adapt to new situations and rapid changes in agriculture.

3. Identify issues and trends in horticulture concerning environmental and conservation problems.

Standard H-10: Understand basic computational and informational technology.

### Benchmark

J. Apply computational and informational technologies to analyze and solve mathematical problems.

1. Measure a tree trunk accurately using a caliper.

Standard H-12: Understand basic technical skills and knowledge in the occupational area of Horticulture.

### Benchmark

L. Apply technical skills in a hands-on experiential setting in agriculture.

26. Identify plants using a botanical key.
27. Identify herbaceous and woody ornamental plants by common name.
51. Explain the process of photosynthesis.
52. Explain factors affecting plant growth: light, water, temperature, humidity, nutrients (micro/macro) soils, atmosphere, and pollutants.
55. Explain the system of scientific nomenclature for plants (e.g., families, genus, and species).
65. Explain the principles of integrated pest management.

## Natural Resources

Standard NR-1: Understand problem solving, analysis, and decision-making in agriculture.

Benchmark

A. Analyze situation, use problem-solving approach and make appropriate decisions.

1. Assess and implement BMPs (Best Management Practices) related to agriculture drainage wells, erosion control, irrigation of wastewater, irrigation of groundwater, use of storage tanks (i.e., fuels, Anhydrous Ammonia, etc.) and wellhead and source of water protection which improve water quality.
6. Evaluate means of solving local water resource problems.
11. Collecting, understanding, and analyzing samples to assess water quality and analyze findings.

Standard NR-4: Understand the use of entrepreneurial knowledge and skills in agriculture.

Benchmark

D. Use appropriate communication skills in a variety of occupational situations in agriculture.

3. Recognize the importance of technical assistance.

Standard NR-7: Understand the principles of planning.

Benchmark

G. Apply planning strategies in natural resources management.

2. Identify the role geologic resources have in land use planning.
6. Develop plans which incorporate the use of federal, state, and local agriculture programs to sustain resources (i.e., buffer strips).

Standard NR-8: Understand the concept of adapting to change in agriculture.

Benchmark

H. Develop strategies to effectively adapt to new situations and rapid changes in agriculture.

1. Identify contemporary natural resources issues/concerns relating to agriculture.
2. Adapt to environment/situation.

Standard NR-9: Understand global and cultural diversity issues.

Benchmark

I. Demonstrate a working knowledge of the relationship between global/cultural diversity and occupational success in agriculture.

1. Describe global environmental impact.
2. Explain global positioning systems and graphic information systems and understand practice application.

Standard NR-10: Understand basic computational and informational technology.

Benchmark

J. Apply computational and informational technologies to analyze and solve mathematical problems.

1. Estimate water needs for a community and farm operation.
2. Measure and calculate land area, length, and percent slope.

Standard NR-11: Understand the concept of career development and improvement – lifelong learning.

Benchmark

K. Develop strategies to make a successful transition from school to work.

1. Identify a minimum of five (5) environmental and natural resource occupations and explain the job requirements, major activities performed by persons in these occupations and availability by location.
2. Explain the connection between the natural resources occupations, agribusiness, and technology.

Standard NR-12: Understand basic technical skills and knowledge in the occupational area of natural resources.

Benchmark

L. Apply technical skills in a hands-on experiential setting in agriculture.

1. Explain the economic impact of the loss of wildlife, habitat, urban sprawl, and navigation on wildlife resources.
2. Identify the agricultural impact of groundwater resource availability, management, and use.
5. Describe the connections between land use, rural Iowa, and agriculture.
6. Locate a plot of land given a legal description.
8. Explain the impact agriculture, industry, and population centers have on natural resources and the environment.
9. Use soil survey, topography maps, aerial photos, and other natural resources inventories to interpret, compare (limits and potentials), and plan wise land management.
10. Identify federal, state, and local regulations related to soil and water conservation, water quality, forestry, air quality, and wildlife. Explain their applicability to resource management.
20. Describe how Iowa climate and weather is relevant to natural resources and agricultural resource management.

21. Identify techniques for improvement of aquatic habitats.
22. Identify a minimum of ten aquatic plants and ten aquatic animals common to Iowa.
23. Select appropriate conservation practices that will reduce erosion and improve water quality on a farm and urban area.
24. Describe the types of wind and water erosion and determine soil erosion rates and resulting economic and environmental losses to society.
28. Explain the importance of protecting ground and surface water resources.
29. Explain proper stocking and management of farm ponds.
30. Explain current issues involved in natural resource management.
31. Explain harvest management techniques and regulations.
32. Describe current animal waste regulations as they apply to the environment.
33. Explain State and Federal Ag and Natural Resource Management Agencies and their functions.
34. Explain the hydrologic cycle.
35. Identify local sources of ground and surface water contamination and explain techniques for protecting these resources.
36. Identify and incorporate nutrient management practices including spreading lagoon fertilizers, commercial applicator training, composting of manure and animal carcasses, managing wastes from food processing facilities through composting, developing manure management plans, the application of municipal sludge, and the storage, handling, and transfer of chemicals into agricultural plans.

## **Agricultural Mechanics**

Standard AM-12: Understand basic technical skills and knowledge in the occupational area of agricultural mechanics.

### Benchmark

L. Apply technical skills in a hands-on experiential setting in agriculture.

26. Identify types of erosion control structures.

**Source:** Iowa Content Standards and Benchmarks for Agricultural Education, Iowa Department of Education, 1999.

## **Science Standards**

*Standard 5: Understands the structure and function of cells and organisms.*

### Level III

3. Knows the levels of organization in living systems, including cells, tissues, organs, organ systems, whole organisms, ecosystems, and the complementary nature of structure and function at each level

5. Knows that organisms have a great variety of body plans and internal structures that serve specific functions for survival (e.g., digestive structures in vertebrates, invertebrates, unicellular organisms, and plants)

### Level IV

3. Understands the processes of photosynthesis and respiration in plants (e.g., chloroplasts in plant cells use energy from sunlight to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment)

4. Knows how cell functions are regulated through changes in the activity of the functions performed by proteins and through the selective expression of individual genes, and how this regulation allows cells to respond to their environment and to control and coordinate cell growth and division

*Standard 6: Understands relationships among organisms and their physical environment.*

### Level IV

1. Knows how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years (e.g., growth of a population is held in check by environmental factors such as depletion of food or nesting sites, increased loss due to larger numbers of predators or parasites)

2. Knows how the amount of life an environment can support is limited by the availability of matter and energy and the ability of the ecosystem to recycle materials

3. Knows that as matter and energy flow through different levels of organization in living systems and between living systems and the physical environment, chemical elements (e.g., carbon, nitrogen) are recombined in different ways

5. Knows ways in which humans can alter the equilibrium of ecosystems, causing potentially irreversible effects (e.g., human population growth, technology, and consumption; human destruction of habitats through direct harvesting, pollution, and atmospheric changes)

*Standard 7: Understands biological evolution and the diversity of life.*

Level III

1. Knows basic ideas related to biological evolution (e.g., diversity of species is developed through gradual processes over many generations; biological adaptations, such as changes in structure, behavior, or physiology, allow some species to enhance their reproductive success and survival in a particular environment)
3. Understands the concept of extinction and its importance in biological evolution (e.g., when the environment changes, the adaptive characteristics of some species are insufficient to allow their survival; extinction is common; most of the species that have lived on the Earth no longer exist)
5. Knows ways in which living things can be classified (e.g., taxonomic groups of plants, animals, and fungi; groups based on the details of organisms' internal and external features; groups based on functions served within an ecosystem such as producers, consumers, and decomposers)

Level IV

2. Understands the concept of natural selection (e.g., when an environment changes, some inherited characteristics become more or less advantageous or neutral, and chance alone can result in characteristics having no survival or reproductive value; this process results in organisms that are well suited for survival in particular environments)
3. Knows how variation of organisms within a species increases the chance of survival of the species, and how the great diversity of species on Earth increases the chance of survival of life in the event of major global changes
7. Knows how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships (e.g., shared derived characteristics inherited from a common ancestor; degree of kinship estimated from the similarity of DNA sequences)

*Standard 12: Understands the nature of scientific inquiry.*

Level IV

4. Uses technology (e.g., hand tools, measuring instruments, calculators, computers) and mathematics (e.g., measurement, formulas, charts, graphs) to perform accurate scientific investigations and communications
7. Knows that investigations and public communication among scientists must meet certain criteria in order to result in new knowledge and methods (e.g., arguments must be logical and demonstrate connections between natural phenomena, investigations, and the historical body of scientific knowledge; the methods and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigation)

*Standard 13: Understand the scientific enterprise.*

Level IV

2. Understands that individuals and teams contribute to science and engineering at different levels of complexity (e.g., an individual may conduct basic field studies; hundreds of people may work together on a major scientific question or technological problem)
3. Understands the ethical traditions associated with the scientific enterprise (e.g., commitment to peer review, truthful reporting about the methods and outcomes of investigations, publication of the results of work) and that scientists who violate these traditions are censored by their peers
5. Understands that science involves different types of work in many different disciplines (e.g., scientists in different disciplines ask different questions, use different methods of investigation, and accept different types of evidence to support their explanations; many scientific investigations require the contributions of individuals from different disciplines; new disciplines of science, such as geophysics and biochemistry, often emerge at the interface of older disciplines)
6. Knows that creativity, imagination, and a good knowledge base are all required in the work of science and engineering

**Source:** Compendium of K-12 Standards, McREL, 2004.

<http://www.mcrel.org/compendium/SubjectTopics.asp?SubjectID=2>