

Living in Water



SUGGESTED GRADE LEVEL: 4

SUBJECTS: Science

SKILLS: analysis, application, classification, communication, description, discussion, drawing, identification, inference, invention, media construction, public speaking, reporting, small group work

CORRELATION TO NEXT GENERATION SCIENCE STANDARDS: 4-LS1-1, 4-LS2-1

Objectives

Students will be able to: 1) identify and describe the advantages of adaptations to an aquatic environment; 2) evaluate the importance of adaptations to a variety of organisms; and 3) describe some environmental conditions that may result in adaptations.

Method

Students will collect information about plant and animal adaptations that occur within aquatic environments.

Background

An amazing diversity of life exists on earth. For instance, there are more than 54,000 named species in Illinois. Scientists estimate 40 to 80 million species of plants and animals live on earth, with about 1.7million identified to date. A quick review of any group of organisms reveals a wide array of subtle differences within the group. For instance, there are about 200 fish species in Illinois, each with a distinct body shape, coloration, feeding habits and reproductive strategy.

These subtle differences are adaptations. An adaptation is an adjustment, often hereditary, an organism goes through to live in a particular environment. Adaptations to the environment allow different plants and animals to fill different niches, or roles, in the environment. This partitioning minimizes competition for the same habitat requirements (food, water, cover, space). Adaptations develop over long periods of time and may be either physical features or specialized behaviors. Because water covers about 75 percent of earth's surface, many adaptations are directly related to water.

Materials

Table 1; paper; colored pencils; markers; research materials; envelopes for paper slips

Procedure

1. Have students research and discuss some of the many adaptations that Illinois organisms possess to help them live in water. A variety of sources of information and illustrations may be used, including videos, magazines, *Aquatic Species Fact Cards*, the Illinois Department of Natural Resources' (IDNR) Web site and other Web sites, and the *Illinois' Natural Resources Trading Cards* series from the IDNR. Table 1 may be copied for student use or used by the educator to stimulate discussion.
2. Using the adaptations outlined in Table 1, write each adaptation on a slip of paper, keeping the major categories (location, coloration, feeding) separated. Have students draw one slip from each major category and illustrate an imaginary creature that would possess all the adaptations. Ask them to name the creature and make an oral presentation to the class, describing it and the habitat it would survive in.
3. Select a particular habitat that the students are familiar with, such as the school grounds or a local lake, and ask them to illustrate a plant or animal that has adapted to live there. Have them list the adaptations it has and how they help the organism survive.

Extensions

1. Using the *Aquatic Species Fact Cards*, *Illinois' Natural Resources Trading Cards*, videos and other sources of information, research aquatic organisms and identify five key characteristics of each. Write a statement of each of the key characteristics and order them from the least obvious to most obvious. Play "Who Am I?" with other students and award 5 points for guessing the organism with the first, or least obvious statement, 4 points for the second statement, etc.

2. Ask students if humans have adaptations. (Yes: opposable thumb, walking upright, highly developed brain, complex language.) Ask students to observe how thumbs are used in a simple task such as picking up a pencil or opening a book. Have students attempt to repeat the exercise after their thumbs have been taped or tied to their palms. Discuss students' reactions. Ask them to consider what tasks would be impossible or difficult if humans did not walk upright or develop language skills?

Evaluations

1. Students should submit their research.
2. Students should submit their drawing.
3. Students should list five adaptations to living in water and give the advantage of each.
4. Students should discuss in a paragraph what types of adaptations would be beneficial in the following locales: pond; fast-flowing stream; stream that dries up in the summer.
5. Give each student an illustration of an aquatic organism. Have them list the obvious adaptations and why they are useful. Ask what types of adaptations might not be obvious from the illustration.

References

Corson, W. E., ed. 1990. *The global ecology handbook*. Beacon Press, Boston. 414 pp.

<http://news.discovery.com/earth/874-million-species-on-earth-110823.html>

<http://www.currentresults.com/Environment-Facts/Plants-Animals/number-species.php>

<http://www.eoearth.org/article/Biodiversity>



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ADAPTATIONS	EXAMPLES	ADVANTAGES
BREATHING		
collect air bubbles under wings	diving beetles (insect)	breathe under water
feathery external gills	caddisfly larva, mayfly naiads (insects)	breathe under water
gills	fishes	filter oxygen from water and release carbon dioxide
skin	frogs (amphibians)	absorb oxygen and release carbon dioxide
FEEDING		
long, thin beak	sandpipers (bird)	probe shallow water and mud for insects
sucker-shaped mouth	common carp, sucker (fishes)	feed on very small plants and animals/keep from being swept downstream
elongate upper jaw	shovelnose sturgeon (fish)	feed on prey it looks down on
duckbill jaw with teeth	muskellunge, northern pike (fishes)	grasp prey
extremely large jaws	largemouth bass (fish)	surround prey
thin beak	semi-palmated sandpiper (bird)	probe mud for food
short, thick beak	golden plover (bird)	glean invertebrates from surface of mud or water
antennae	crayfish (crustacean)	sense prey
worm-like lure on tongue	alligator snapping turtle (reptile)	attract prey
skin	frogs (amphibians)	absorb water through skin so no need to drink
two eyes on each side, one peering above water, the other below	whirligig beetle (insect)	locate prey and predators
APPENDAGES-LOCOMOTION		
shoot water out the rear of its body	dragonfly nymph (insect)	movement through water
webbed feet	ducks, geese (birds), river otter (mammal)	propulsion through water or mud
long toes	great blue heron (bird)	aid in walking on mud
long, slender legs	great blue heron (bird)	aid in walking in water
hard, crescent-shaped spade on foot	spadefoot toad (amphibian)	burrow underground to escape heat and predators
long, muscular legs	leopard frog (amphibian)	escape predators
fins	fishes	movement through water and stabilization

ADAPTATIONS	EXAMPLES	ADVANTAGES
split second claw on hind foot	beaver (mammal)	used like comb to groom fur for maximum water repellence
modified toes on front paws	beaver (mammal)	grasp food and materials used to build dams
long front claws	beaver (mammal)	digging
tail	aquatic salamanders (amphibians)	swimming
broad, flat tail	beaver (mammal)	used as a propeller and rudder when swimming and support when sitting upright to gnaw on tree
BODY SHAPE		
torpedo shape	trout (fish)	fast movement
flat belly	channel catfish, sucker (fishes)	bottom feeder
vertical disk	bluegill (fish)	feed above or below/move in vegetation
flat back	topminnows (fishes)	feed at the surface
long legs, light body	water strider	skate on water's surface tension
COLORATION		
light colored belly	perch, minnows (fishes)	predators have difficulty seeing it from below
dark upper side	bluegill, crappie (fishes)	predators have difficulty seeing it from above
vertical stripes	bluegill, muskellunge (fishes)	can hide in vegetation
horizontal stripes	yellow bass, white bass (fishes)	can hide in vegetation
mottled coloration	hogsucker, trout (fishes)	can hide in rocks and on bottom
striking color pattern	spotted salamander (amphibian)	warn potential predators of poison glands in skin
REPRODUCTION		
eggs deposited on bottom	trout, minnows (fishes)	hidden from predators
eggs deposited in nests	bass (fishes)	protected by adults
floating eggs	striped bass (fish)	dispersed in high numbers
eggs attached to vegetation	perch, carp, northern pike (fishes)	stable until hatching
short reproductive cycle	toad (amphibian)	produce young before water dries up
long, tangled strings of eggs	hellbender (amphibian)	eggs not lost in rapidly moving water

ADAPTATIONS	EXAMPLES	ADVANTAGES
SURVIVAL IN TEMPERATE CLIMATE		
migration	ducks, herons (birds)	move to areas with more food and longer daylight
burrow under mud in pond	frogs (amphibians), turtles (reptile)	remain below freezing surface temperatures
dig deep down into the soil	toads (amphibians), earthworms (invertebrates)	remain below freezing surface temperatures
thick fur and layer of fat	beaver, muskrat (mammals)	maintain body temperature and utilize fat for food
tissues can freeze	wood frog (amphibians)	body can freeze and thaw
SURVIVAL IN WATER		
castor glands	beaver (mammal)	oil coats and waterproofs fur
oil glands	ducks, geese (birds)	oil coats and waterproofs feathers
nose and ear flaps	beaver (mammal)	seal out water when diving
front teeth project through lips	beaver (mammal)	gnaw, chew and swallow while under water
keen sense of hearing	beaver (mammal)	hear flowing water that threatens dam
sensitive to shadow and movement	trout (fishes)	to escape predators
PROTECTION		
retreat into shell	snails (invertebrate-mollusk), turtles (reptiles)	protection from predators
exoskeleton and claws	crayfish (crustacean)	protection from predators
flat tail	beaver (mammal)	warn others of danger
camouflage–color	American bittern (bird)	hide in cattails
camouflage–shape	American bittern (bird)	hide in cattails
scales with mucous	fishes	protect from bacterial and fungal infection
skin and shell	turtles (reptiles)	sense vibrations in water
two eyes on each side, one peering above water, the other below	whirligig beetle (insect)	locate prey and predators
spines	bony fishes	protection from predators
spines with venom	catfish (fishes)	protection from predators
mucous	salamander (amphibian), eel (fish)	slick skin to escape predators and parasites

ADAPTATIONS	EXAMPLES	ADVANTAGES
poisons	toads, salamanders (amphibians)	protection from predators
BEHAVIOR		
freezing in place	American bittern (bird)	hide in cattails
flocking	red-winged blackbird (bird)	safety in numbers
mobbing	red-winged blackbird (bird)	harass predators
alarm	beaver (mammal)	protection
bluffing	killdeer (bird)	pretends broken wing to distract predators
schooling	minnows (fishes)	safety in numbers and mass appears as one large fish
PLANTS		
develop "knees"	baldcypress (tree)	oxygen absorption
hollows in stems and leaves	cattails	oxygen absorption
float on water	duckweeds	absorb nutrients and minerals, maximize sunlight
tiny hairs on flat sacs	bladderwort	trigger sac to expand and suck in insects
stems and roots	water lily	store food for winter
air spaces in stem	water lily	store extra oxygen and help keep afloat
foul odor	skunk cabbage	attracts flies to carry pollen
delay germination	lotus, bulrush	maximize seed bank for ideal growing conditions
timing of seed production	annuals on mud flats	maximize seed bank for ideal growing conditions
winged seeds	silver maple (tree)	dispersal
structure of body	pitcher plant	collect water and trap prey
vines	poison ivy, greenbriar	grow in trees above floodplain soil