[5.210 - exotic and native species - above aquarium - 134 words]

Something Is Clearly Wrong

On the left, small striped mussels are making themselves at home in clean, clear water. In the other tank, the water is cloudy . Which is the healthier environment?

Even though it looks dirty, the cloudy tank contains tiny plants and animals that are typical of a healthy water ecosystem.

The clear tank contains zebra mussels, a European species accidentally carried to the Great Lakes in the ballast tanks of cargo ships. Since the mid-1980s, tens of millions of zebra mussels have spread throughout the lakes and into the Mississippi, Ohio and Hudson rivers.

These mussels feed on algae and plankton living in the water, but they're so good at it that they leave little food for other animals in the lake. The water gets clearer, but other animals starve.

[5.210 - exotic and native species - side panel - 272 words]

Species out of Place

Ecosystems are complex webs of plant and animal interdependencies that develop over hundreds of years. When a species from one ecosystem is transplanted into a completely different ecosystem, it can be very disruptive.

For example, while the zebra mussel is a food source in its native European habitat, it has no natural predators in the Great Lakes and in a very short time, the zebra mussel population has exploded. Biologists call these kinds of animals invasive exotics.

Sea Lamprey (*Petromyzon marinus*)

Sea Lampreys are parasites that attach to the sides of fish, sucking out blood and body fluids. These parasites have almost wiped out lake trout and also attack salmon, cisco, and whitefish. Native to the Atlantic Ocean, Sea Lampreys first entered the Great Lakes in the 1930s through the St. Lawrence Seaway and the Welland Canal near Niagara Falls.

Alewife (*Alosa pseudoharengus*)

Alewife are not native to the Great Lakes, but when they first moved in from the Atlantic Ocean in the 1930s, lake trout kept them under control. As sea lamprey killed off the lake trout, the alewife population exploded. By the 1960s, the lake ecosystem could no longer support the huge numbers, and millions of dead alewife began washing up on shore.

Purple Loosestrife (*Lythrum salicaria*)

Purple Loosestrife was brought to New England from northern Europe in the early 1800s as an ornamental flower. Since then, it has spread north into Canada, south to Alabama and west to California. Once it takes root in a wetland, loosestrife can quickly spread to cover thousands of acres of formerly open habitat - crowding out native animals and plants.

[5.300 - west intro to river model - 105 words]

Urban River

Two hundred years ago, the Chicago River was a small prairie stream, winding through colorful wetlands on its way to Lake Michigan. It also provided a shortcut for 18th century traders moving between the Great Lakes and the Mississippi River system.

Today, the Chicago River is very much an urban river. Cargo ships move along its concrete banks. Engineers have redesigned it to be straighter, wider, and deeper. And it now flows away from the lake instead of into it.

Through it all, the Chicago River is still a living river and home to a wide range of plants and animals – including us.

[5.300 - east intro to river model - 97 words]

Rural River

The banks of a healthy river support a wide variety of animal and plant species and a range of ecosystems.

As you walk along a healthy river, you'll see places were it is wide or narrow, shallow or deep, fast-moving or slowly flowing along. These changes in the river's condition help maintain an environmental balance.

A river connects landscapes – rural and urban. Healthy rivers can be places where people work in harmony with the natural forces that create and shape the river.

[5.310 - river model - urban river - rear - 116 words]

Life on the Lake

Lake Michigan supports a wide variety of ecosystems. The sandy beaches, coastal marshes, shallow bays and cold dark depths of the lake provide habitat for hundreds of different kinds of plants, land animals, birds and fishes.

The lake is also a vital resource for more than 30 million people. We drink from it, fish in it, swim in it, and sail on it. We also build homes and factories next to it, haul cargo over it, and dump wastes into it.

While it took thousands of years of glacial action to create Lake Michigan, in just the past 200 years it has been transformed by the cities and towns that surround it.

[5.310 - river model - urban river - front A - 52 words]

Drinking the Lake

What comes out of your faucet at home? Lake Michigan! Chicago and many suburbs draw their water from the lake. It's collected offshore at large intake structures called cribs. About a billion gallons a day are pumped into water treatment plants, which purify the lake water into drinking water.

[5.310 - river model- urban river- front B - 193 words]

Channeling Nature

As the city of Chicago grew, the wetlands along the river were drained for land to build farms and factories. To make it easier for ships to load and unload, the river has been straightened, widened, deepened, and its banks have been lined with concrete and wooden pilings.

A construction accident in 1992 broke through one of the tunnels built under the river and flooded downtown Chicago.

The Locks : Gates Between River and Lake

Soon after the river flow was reversed, another problem surfaced: the reversed river drained too much water from the lake. To slow the flow from the lake, a lock system was built in the 1930s.

Try your hand at running a lock system. Turn the cranks to open and close the lock gates.

Locks act like an elevator for ships moving between two bodies of water – the lower river level and the higher lake level. A ship sails into one side of the lock and the gates are closed. Water is pumped in or out to raise or lower the ship to the level on the other side. The opposite gates are then opened and the ship sails out.

[5.310 - river model - urban river - front C - words]

A River Runs Backwards

Before 1900, the Chicago River flowed into Lake Michigan. Sewage dumped into the river polluted the lake – and the city's drinking water – with bacteria that caused typhoid, cholera, and other deadly diseases.

The Sanitary and Ship Canal was built to divert the river away from the lake and keep sewage out of the city water supply. Since 1900, the Chicago River has flowed "backwards" down this canal – out of Lake Michigan, through the Illinois River and on to the Mississippi. Now, sewage treatment plants clean up wasterwater before discharging it into the river.

[5.320 – river model - urban runoff - rear - 123 words]

What's the Point?

The city is a hard place – literally – covered with cement, asphalt, bricks and stone. Even lawns and park lands are made up of tightly packed soil. These surfaces are so dense that, when it rains, most of the water can't sink into the ground and runs off into sewers and waterways.

During a rainstorm, millions of gallons of water wash over the city and pick up pollutants like motor oil, road salt and lawn fertilizer. This kind of water pollution is called nonpoint source pollution because it comes from many sources spread over a wide area rather than from a single point.

In fact, most of the water pollution in Illinois is produced by runoff from streets, farms, construction sites, lawns and other nonpoint sources.

[5.320 - river model - urban runoff - front - 139 words]

Deep Tunnel

Pull the blue lever and start a rainstorm.

In Chicago, combined sewer systems collect rain and snowmelt along with waste from

drains and toilets. This waste water runs to sewage treatment plants, where it is cleaned before it's put into the river. In other areas of this region, separate sewers carry storm water directly into lakes and rivers.

Heavy storms or snowmelts produce more runoff than city sewers and treatment plants can handle, causing untreated sewage to be released into the river. If sewage gets past the locks and into Lake Michigan, it can cause beach closings and pollute our drinking water.

Pull the yellow lever and lower the floodwater.

The Deep Tunnel is part of a series of tunnels and reservoirs built to hold waste water until the sewage treatment plants are ready to process it.

[5.330 - river model - sedimentation - rear - 123 words]

Muddy Waters

As rainwater runs along the ground, it picks up particles of soil, sand, and soot. If these sediments wash into a river or lake, they can damage the ecosystem. Sediments are a major type of nonpoint source pollution.

Sediments suspended in the water can keep sunlight from reaching aquatic plants. Water insects and fish also have a hard time breathing in muddy waters – sediment clogs their gills.

Turbid water – cloudy with sediment – also absorbs more heat from the sun. The rising water temperature affects the kinds of plants and animals that can survive in it.

And when sediment settles to the bottom it can spread like a smothering blanket over fish eggs, mussels, and other living things on the river bed.

[5.330 - river model - sedimentation - front - 138 words]

Pull the red lever and watch what runs off into the water.

What kind of sediment is washing into the river? It depends on what's happening along the banks and in the watershed.

Plant root systems reinforce the soil along the river bank and keep it from washing into the river.

Construction sites are another source of runoff that carries sand, soil and other building or excavation debris into the water.

Rainstorms can cause freshly-plowed fields to lose a lot of the soil that has been exposed by plowing.

Runoff from paved areas can contain a range of urban residues: soot from burning fuel, bits of rust , and oils from asphalt.

Today, management practices like no-till farming, silt fences along construction sites, and detention basins for runoff can help reduce nonpoint source pollution.

[5.340 - river model - eutrophication - rear - 106 words]

Too Much of A Good Thing

Fertilizer, sewage, and animal waste contain nitrogen and phosphorus – two chemicals that all plants need to grow. When these nutrients wash into the river, they can set off a harmful chain reaction.

The over-abundance of nutrients triggers the growth of microscopic plants called algae. During one of these algal blooms, billions of algae can actually tint the water green.

As the algae die, bacteria decompose them, using up oxygen from the water. As the oxygen level in the water drops, fish and other aquatic animals also die.

Nutrients and sediment are the major causes of water pollution in Illinois.

[5.340 - river model - eutrophication - front - 99 words]

Breathing Room

Nutrient overloading is also called eutrophication – a term that means "well-fed." A 'well-fed' waterway can be dangerously short on oxygen.

Waterfalls and riffles aerate the river by mixing atmospheric oxygen back into the water and enabling fish and other animals to breathe.

But the best way to protect the ecosystem is to keep extra nutrients out of the water in the first place: by using less fertilizer on farms, lawns, and golf courses; by treating sewage and animal waste; and by protecting wetlands and stream-side vegetation that absorb nutrients before they reach the river.

[5.350 - river model - wetlands - rear - 98 words]

Wetlands

Wetlands are low-lying, water-saturated areas that often border lakes and rivers, providing a safe haven for fish, birds and other animals to breed and grow. Midwestern wetlands are distinguished by their soil chemistry and vegetation:

Marshes at the edges of lakes and streams host rushes, reeds and other plants that can grow with their roots submerged in the water. Fens are alkaline wetlands, created by water seeping up through underground limestone. Bogs are acidic wetlands, made so by decaying plants under the water. Swamps are distinguished by the trees, like cypress, that grow in them.

[5.350 - river model - wetlands - front - 108 words]

Vanishing Resource

Pull the yellow lever and see how wetlands respond to the rising river.

Wetlands soak up rainwater and release it slowly into rivers or underground aquifers. The tangled roots of wetland plants form a living sponge that retains floodwater, prevents erosion, slows runoff and filters out sediment and pollutants.

For a long time, a common misconception was that wetlands were slimy, stagnant, disease-ridden places. As a result, 90% of the original wetlands in Illinois have been drained, filled, converted to farmland, or built over.

Today, we have a better appreciation of the importance of wetlands, and conservation efforts are underway to protect these treasured ecosystems.