

Lesson 3 ANSWER KEY:

Hudson River Ecology: Exploring Abiotic Changes

Part 1:

List at least three abiotic factors that shape the Hudson River ecosystem.

- 1.) Temperature 2.) Turbidity (water cloudiness) 3.) Dissolved Oxygen
Or: pH, pollution, total suspended solids, salinity, water velocity/current, soils or geology

Predict how the invasion of zebra mussels might affect an abiotic factor of the Hudson River.
I think the invasion of zebra mussels will decrease the turbidity of the water in the Hudson River, because the zebra mussels are continuously filtering particles from the water column that would otherwise make the water very cloudy.

Part 2:

- How does Dr. Strayer help the viewer visualize the size of the zebra mussel population in the Hudson River?
Dr. Strayer uses the example of a scale – if you put all of the zebra mussels on one side of the scale, they would outweigh all of the other biota in the river.
- In the space provided, indicate the biotic and abiotic factors mentioned in the video that were most affected by zebra mussel invasion. For each, state if they increased or decreased:

Biotic Factors	Abiotic Factors
-Decrease in phytoplankton populations (80% loss) -Decrease in small zooplankton populations (90% loss) -All zooplankton declined (50% loss) -Open water fish suffered (had less food) -Greater biomass of zebra mussels than all other consumers -Increased growth of shallow water rooted plants -Shallow water invertebrates and fish increased -(Part 4 results)- zebra mussels life span decreased, also decreased in size	-Dissolved Oxygen decreased 12% -Decreased turbidity (water cloudiness) -Shallow water is clearer, more sunlight penetration

Part 3 – The Future – Video 4

1. Cary Institute scientists explain that, in the later years of zebra mussel invasion, some organisms' populations began to recover. Which organisms benefitted from the zebra mussel invasion in the long term? How did they benefit?

As a result of the changing size classes of the zebra mussels, many of the organisms' populations have begun to recover. However, phytoplankton numbers remain low, which scientists are studying to understand why.

2. Below, give one example of how biotic factors (organisms) in this river ecosystem affected the abiotic environment in this flow chart. Use examples of factors Cary Scientists explored in their study. A general example for trees along a stream might be:

Trees (biotic) → Lower Water Temperature → More trout

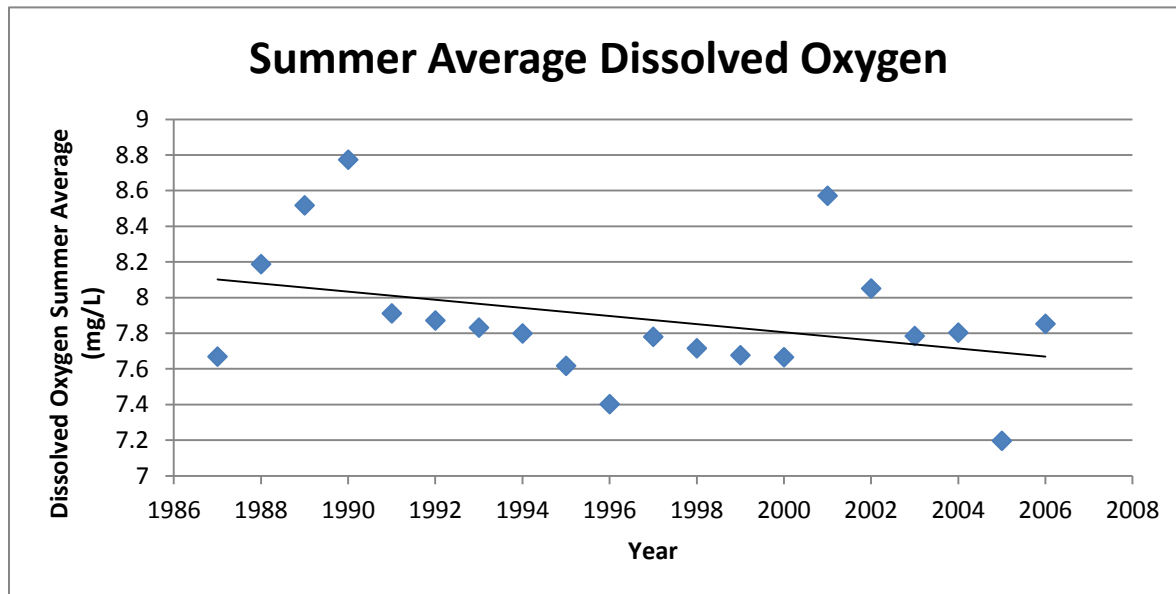
Zebra mussels → increased water clarity → more plant growth in shallow zones
Zebra mussels → increased water clarity → more fish in shallow zones

3. **In video 4**, Cary institute scientists state that long-term monitoring of ecosystems is important. Provide support for this statement.

Without long-term monitoring, we wouldn't know how the zebra mussel story "changed" over time. For example, we wouldn't know that some organisms have begun to recover. We also likely wouldn't have known about the changes that happened to the open water and the littoral parts of the ecosystem. As scientist David Fisher says, "The more information you have, the more you can pinpoint what's causing the changes in the river." Through their long term study, Cary scientists discovered that the life span of zebra mussels was becoming shorter over time. This affected what types of organisms the zebra mussels could eat. Because zebra mussel survival rates were decreasing, and their were also decreasing in size, this meant they could eat fewer zooplankton. Many populations of organisms, including zooplankton species, in the Hudson River started to recover as a result of this change. The scientists would not have seen the recovery of different organisms affected by zebra mussels if they hadn't studied the invasion for a long period of time.

Part 4: Making Connections

Use the graph below to answer questions #1-2.



This graph shows the average dissolved oxygen in the Hudson River over the summer seasons, both before and after the zebra mussel invasion.

1. What trend do you notice in this graph?

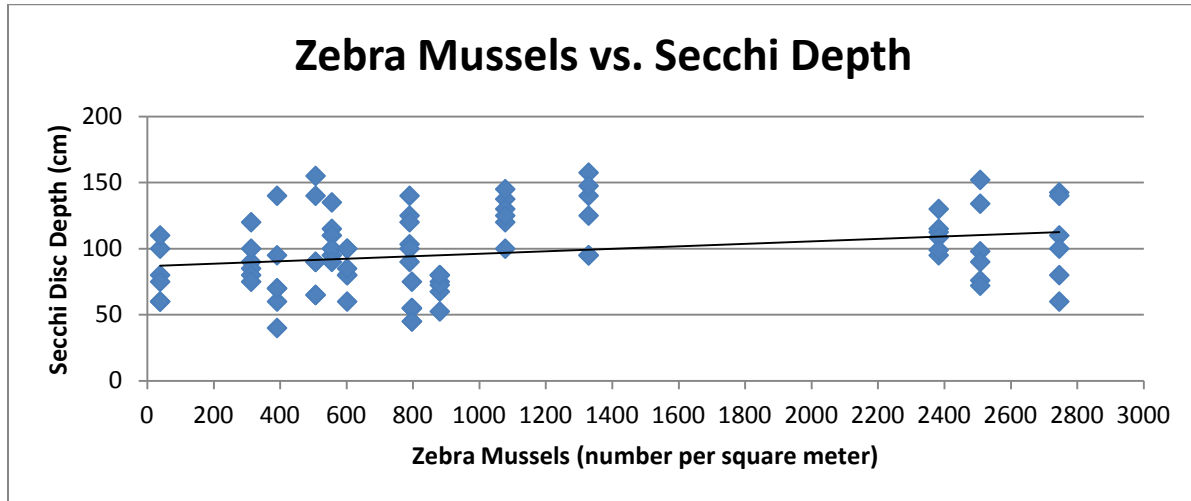
Dissolved oxygen levels decrease over time in the Hudson River.

2. Why does this graph only include data for dissolved oxygen in the summer?

Phytoplankton are most active, and produce oxygen through photosynthesis, during the summer.

3. Give two reasons why scientists thought zebra mussels affected this change:
 - a. Zebra mussels are consuming oxygen in the water through respiration.
 - b. Zebra mussels are causing a decline in phytoplankton populations, thus decreasing the amount of oxygen these phytoplankton produce via photosynthesis.

Use the graph below to answer the remaining questions.



The graph above shows how the depth of the Secchi Disc changed with the number of zebra mussels found in the Hudson River. The **Secchi Disc** is an instrument that scientists use to measure how deep into the water sunlight can penetrate.

4. Which organisms in the Hudson River ecosystem depend upon sunlight to live?

Rooted plants in the shallow water, and phytoplankton. Both perform photosynthesis.

5. How did increases in zebra mussel populations affect light penetration in the Hudson River?
What was the result of this change on the broader ecosystem?

Zebra mussels are filter feeders. As they fed, they filtered particles out of the water, including suspended solids and organic materials, as well as organisms such as phyto- and zooplankton. As a result, light penetration increased in the Hudson River. Increased sunlight promoted the growth of rooted aquatic plants. As these plants populations increased, so did the populations of shallow water fish that used the plant beds for feeding and as nurseries.

6. How does the Secchi disc graph support these conclusions?

Increased Secchi depth = increased water clarity = increased light penetration = more photosynthesis and growth by shallow water plants.