

## Hudson & Eutrophication Answer Key

### Step 1: Answers

1. It went above very eutrophic line eight times.
2. The Hudson was more likely to be very eutrophic during low tidal ranges.
3. During times of low tidal range, the phytoplankton had more time to reproduce, adding to the gross primary productivity of the river. These data are for the lower Hudson, where the tidal mixing is much stronger, and thus stratification breaks down more easily.
4. The lower, saline Hudson is 'flushed' every day.
5. The Hudson is less sensitive to nutrient pollution than other estuaries because of the rapid flushing rate.
6. The Hudson would quickly show visible signs of eutrophication.
7. The two things that affect the amount of phytoplankton production are the range of the tides and the amount of water discharged into the river.

### Step 2: Answers

1. The total nitrogen amounts changed from  $49 \times 10^3$  tons per year to  $43 \times 10^3$  tons per year. The phosphorus changed from  $9.6 \times 10^3$  tons per year to  $4.8 \times 10^3$  tons per year. This probably happened due to improvements in wastewater treatment plants, as well as a ban on phosphates in detergent.
2. The majority of the 1990s nutrient input comes from wastewater treatment plant effluent.
3. Upriver tributaries contribute nutrients in the form of runoff from agricultural lands.
4. Farmers could reduce the amounts of fertilizers they use, and properly dispose of their animals' waste.

### Step 3: Answers

1. BOD: 32% removed after primary, 92% after secondary, and 93% after nutrient removal
2. Nitrogen: 23% removed after primary, 37% removed after secondary, and 77% after nutrient removal
3. Phosphorus: 33% removed after primary, 50% after secondary, and 75% after nutrient removal
4. A  $1,500 \text{ m}^3$  treatment plant using secondary treatment would cost \$420/day or \$153,300/year. A nutrient removal treatment plant would cost \$555/day or \$202,575/year.
5. Nitrogen benefits the most from the nutrient removal process. Depending on the student, they may or may not believe that the cost is justified.