**Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_**

**Lesson 1 - Exploring Hudson River PCB Data**

**Part 1: Background reading.** Using the reading, please answer the following questions:

1. What are PCBs, and why are people concerned about them?

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| *PCBs are a class of man-made chemicals called Polychlorinated Biphenyls. People are concerned about PCBs because consumption of them has been linked to a number of health effects such as cancer, reduced immune responses, low birth weights and learning disabilities.* |

1. Where do most of the PCBs in the Hudson River come from?

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| *PCBs in the Hudson come mostly from two plants owned by General Electric where they were used as fire preventatives and insulators* |

1. What is The Superfund Act, and why is the Hudson a site?

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| *The Superfund Act pays for cleanup of abandoned or uncontrolled hazardous waste sites, and the Hudson was designated as a site because of the PCB contamination.* |

1. How do fish get PCBs in their bodies?

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| *By eating contaminated plankton through the process of bioaccumulation. The smaller organisms take it up from the sediment.* |

1. Where do PCBs generally accumulate in a fish?

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| *In the fat cells or lipids.* |

1. What factors determine the level of PCBs in a fish? Name at least three:

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| *What it eats* |
| *Where it lives* |
| *The amount of fatty tissue it has* |
| *Its age* |

1. Compare the levels of PCBs in Hudson River fish with those found in fish from other locations in the United States.

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| *PCBs are higher in the Hudson than other rivers on the East Coast* |

1. What is the supermarket standard or "acceptable" level of PCBs in a fish for consumption as determined by the Food and Drug Administration?  *2ppm*
2. Explain the process used to sample fish in the Hudson River.

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| *State scientists collect fish from different places in the Hudson and send them to a lab to be analyzed for PCBs* |

1. Explain how the Hudson is being cleaned up.

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| *The Hudson has been dredged to remove sediment contaminated by PCBs* |

1. Why will fish in the Hudson River still have PCBs for many years to come?

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| *Because of bioaccumulation, PCBs already in the food web will continue to move through it for many years.* |

1. Go to <http://www.health.ny.gov/environmental/outdoors/fish/hudson_river/> and find out some more specific information about New York, or use the handout provided by your teacher.
   1. For women under the age of 50, and people under the age of 15, how many fish can be eaten safely from the Hudson River south of the Corinth dam?

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| *None* |

* 1. For men over the age of 15 and women over the age of 50, explain the fish advisory in the county where YOU live:

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| *This will depend on information specific to the student* |

**Part 2: Exploring Data** *Answers to questions 1-7 in this section will depend on student data*

1. Get an envelope with striped bass fish data from your teacher. These are data from one fish collection date in 2008 from Catskill, NY.
2. Sample 3 times from your envelope (which represents the Hudson River). Record the PCB level in each fish and then find the average PCB levels of your three fish in ppm:

\_\_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_

Average:\_\_\_\_\_\_\_\_\_\_

1. Based on this number, would you say that fish in the Hudson River are above the federal standard for PCBs of 2 ppm? Why or why not?

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1. Share your average with the class. Write down all of the other averages found by the other groups, and then find the average of the averages:

|  |  |
| --- | --- |
| Group | Average |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |
| Class Average | 1.09 |

1. How did your three fish - your sub-sample - compare with the other groups’ sub-samples? (Is your average the same as, higher, or lower than the other averages?)

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1. How does your sub-sample compare with the class average? (Is it the same as, higher, or lower?)

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1. Based on the class average and the small sub-sample averages, would you revise your answer to question #4 about fish being above the federal supermarket standard? Why or why not?

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1. Now, create a histogram with all of the data in your envelope. Shade in the boxes above the PCB level for each fish. Label the values that are ABOVE 2.0 ppm so that you know how high the PCB levels are in those fish. Then calculate the average for the entire dataset and mark it’s location with an X on the histogram.

PCB Levels in Striped Bass in 2008 in Catskill, NY

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Frequency | 11 |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |
| 1 |  |  |  |  |  |  |  |  |
|  |  | 0.0 to 0.4 | 0.41 to 0.8 | 0.81 to 1.2 | 1.21 to 1.6 | 1.61 to 2.0 | 2.1 to 2.4 | 2.41 to 2.8 | 2.81 and above |
|  |  |  |  |  | PCB level (ppm) | | |  |  |

1. Calculate the probability that you will catch a fish that has a PCB level that is higher than the supermarket standard of 2ppm. Divide the total number of fish by the number over 2ppm:

Number of fish over 2ppm: 3

Total number of fish caught: 19 = 0.16

1. Think again about your answer to #3. Are fish in the Hudson River above the supermarket standard? Explain your answer.

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| *This is a thought question, there is no right answer as long as the student justify their position* |

1. Look at these data for striped bass that were sampled in the same location but in a different year. Compare the data from the two years. What similarities and differences do you notice (use the box at right)? The mean for the dataset is 1.06ppm (marked with an "X" below).

X

*Similarities:*

*-shape is similar*

*-means are similar*

*Differences:*

*-there are more values closer together in 2008*

*-the most common value is lower in 2008*

*-2008 has a more skewed distribution*

1. Based on the two graphs, which data set has less variability - or, in other words, in which year are the PCB levels in the fish more similar to one another?
   1. Circle the year: 2008 or 2002
   2. Explain:

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| *2002 has less variability because there is a smaller range of PCB levels in the fish* |

1. Here is some descriptive information about the two sets of data.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Sample Size of fish | Average (PCB ppm) | Standard Deviation of PCB ppm | Probability of catching a fish ≥ 2ppm |
| 2002 | 16 | 1.06 | 0.54 | 19% |
| 2008 | 19 | 1.09 | 1.19 | 16% |

a. From the graphs and the information above, what do you think the standard deviation tells you about a set of data?

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| *It tells you about the variability in the data* |

b. Imagine that you went fishing in 2002, and again in 2008. You caught and ate a striped bass each year. In which year is it more likely that the striped bass you ate had a PCB level that was higher than the FDA supermarket standard of 2ppm?

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| *In 2002 it is more likely because a higher percent of fish were above the supermarket standard.* |

1. Let's practice what we've learned with some additional data, from a different location in the river (further north, near Troy, NY).

Here are some summary data about these two samples:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Sample Size of fish | Average (PCB ppm) | Standard Deviation of PCB ppm | Probability of catching a fish ≥ 2ppm |
| 2007 | 11 | 2.49 | 1.06 | 82% |
| 2011 | 10 | 2.43 | 2.31 | 50% |

a. Based on this information, which sample has the higher variability? Describe the variability.

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| *2011 has higher variability because it has a higher standard deviation and a bigger range.* |

b. If you had caught striped bass in both years, and put them in your freezer to eat later, which one would you rather eat - a bass caught in 2007, or one caught in 2011? Why?

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| *In both years, the average is above the supermarket standard, so neither is good to eat. But it’s better to eat the one from 2011, because a lower percentage of caught fish are above the supermarket level due to the higher standard deviation from the mean.* |

1. How did your answer to question #3,"Are Hudson River fish below the federal standard for PCBs?" change during this activity?

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| *This will depend on the student* |

1. Based on this activity, would you say it is OK to eat striped bass from the Hudson River? Why or why not? If you are not comfortable, what else would you need to know in order to make an informed decision?

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| *This will depend on the student* |