Snapshot Day Lesson Plan – Designing A Study

Background: Designing a science study is an important part of answering questions in an Earth System science. Students, in their eagerness to learn more about the Hudson River system, often select study topics that are too large to study effectively given the resources available to them. One of the most difficult topics to research is a **subject that varies** over **time** and **space**. The purpose of this lesson is to encourage them to think about sampling techniques, the strengths and weaknesses of specific techniques in differing situations and study designs, and how to better limit a science research question.

Summary: Students are asked to consider designing a study to identify all the types of fish in the Hudson River. Reviewing several different sets of fish data that are available students are asked to critique two different study designs that are suggested.

Objective: Students will
- work with actual fish data from both Snapshot Day 2004-2006, and seasonal seining data from Beczak Environmental Center
- Assess what is meant by a "representative sample"
- Determine how to test their findings
- Determine how to improve the study design

Subject areas: science, (includes some basic math and language skills)

Standards: MST 4, MST 3, ELA

Skills: basic mathematical computations, interpreting data, communicating

Vocabulary: sampling, parents population, representative sample, brackish, seine,

Estimated Duration:
Preparation Time: 10 minutes
Activity Time: 30 minutes

Materials:
- One worksheet per student
- pencil
- calculator if desired

Background:

The Hudson River flows for the Adirondacks to the Atlantic Ocean, some 315 miles from one end to the other. The upper ~153 miles of the river is a true freshwater system with water draining from the upper watershed in freshwater tributaries. The lower ~153 miles of the Hudson River is referred to as an *estuary*. In this lower section of the river there are tidal and ocean influences. In the Southern most end saltwater comes from the Atlantic and mixes with the freshwater from the north creating water of moderate salinity referred to as *brackish*. The

Hudson has a range of salinity environments, effecting what type of fish will be successful in each area. The most southern sections of the river are home to fish species that can be found in the ocean, in the brackish section there are another grouping of fish that can be successful in shifting salinities, and in the northern freshwater sections there is a mix of more inland fish species. Identifying all the species of fish in the river would involve assessing the fish population over two very important parameters - **time** and **space** – and would be extremely challenging for a student research project.

Activity Answers: (*Answers in bold italics*)
1. Will it be possible to design a study to locate and identify each individual fish in the Hudson River?
   NO it would not be possible

This tally represents three years of data. Each data was collected (a) **at the same place**, (b) **using the same equipment** and (c) **at the same time of year**. . These are all important things to consider in designing a study. Why would it be important to consider each of these items in designing your study (give at least one reason supporting each item [(a), (b) and (c)], and one reason why each item could be a problem in a study design.)

2. ***Supporting: (a) Sampling at the same place repetitively will enhance your chances of gathering a more complete sampling of that particular location (b) Sampling with the same equipment provides a measure of consistency in a study and improves the chances of replication. (c) Sampling at the same time of year is another consistency measure.***

   Each of these items can be important positive considerations in certain study designs, <u>but</u> each is actually a weakness in the study topic selected which hopes to gather data which will vary over time and space. All three of these items is a strong consistency sampler, but we are hoping to gather a full range of responses which looks at variety and differences.

3. Based on the information above you conclude that there are a total of 4 different types of fish present in the Hudson River and you turn in your report with this information. When you meet with your research advisors what do you think they will say about your findings:

   a. Is the fish tally above a **representative sample** of all the types of fish in the Hudson River? List at least two reasons why you think it is, or it is not.
   1. ***All the fish were sampled on only one day of the year – seasonal patterns occur.***
   2. ***All the fish were collected using only one type of equipment – certain equipment favors certain species of fish.***
   3. ***All the fish were collected in one geographic location on the river – the Hudson River varies from salty, to brackish, to freshwater, as well as differing habitats such as marshes, freshwater riffles and pools, and even piers and other structures attract some fish.***
   4. ***All the fish were collected along the shallow edge of the river, none from the deeper sections – there are certain species of fish that prefer to travel in the river in the deeper channels, others that select the shallow edges.***

5. There are certainly other answers that would be correct as well.

b. Scientists are always interested in doing more testing to see if their study is repeatable, or if there might be another explanation for the **findings** (conclusions) in the study. How could you test your results to see if you were right?

There are many ways you could test your results to see if they were correct taking into account any of the answers to question (a) above. Also it is important to note that only one of the types of fish (Atlantic silverside) was caught on all three years of data collection. This suggests the results would vary with further study since they are not consistent in the 3 years sampled.

c. List some ways you could improve the design of this study to be sure you get a **representative sample** of all the types of fish found in the Hudson River?

Again there are many ways this study could be improved including sampling over various seasons, weather events, geographic locations, locations that vary in habitat, locations that vary in salinity, sampling with a variety of equipment, from a pier, beach and boat etc.

3. You now have data collected (a) **at the same place**, (b) **using the same equipment** <u>but</u> at (c) **different times of the year.** This change from your earlier study design is important to consider. Can you provide at least one reason why this change would improve your study design?
By adding differing times of year you will collect fish that might use the river (or even sections of the river) seasonally: for spawning, or travel in on warm water currents, or move upriver as salinities vary with weather adjustments.

4. Complete the totals boxes to see which species of fish they caught the most samples of.
Totals for missing numbers:
Atlantic Silverside: 38
Bluefish: 11
Mummichog: 13
Striped Bass: 178
Flounder: 14
White Sucker: 2
Naked Goby: 3

5. List the top 4 species caught during this sampling period.
      a. Bay Anchovy
      b. Striped Bass
      c. White Perch
      d. American Eel
6. Do the top four samples caught match the four species caught at this location on Snapshot Day 2004-2006?
No they don't

7. What will you put in your report to explain why the results of this sampling period do not match the results from Snapshot Day 2004-2006?

>*The results from Snapshot Day were all from October, and they were one day events. As we noted earlier there was only one fish type that was caught each of the 3 Snapshot years sampled. These seasonal seining results cover a longer period of time, with more intensive sampling, and should be more representative of the fish communities in this area of the river at this time of year.*

8. Based on the information above you come up with a new conclusion. You conclude there are actually a total of 21 different types of fish present in the Hudson River and you turn in your report with this information. When you meet with your research advisors what do you think they will say about your **findings** (conclusions):

d. Is the fish tally above a **representative sample** of all the types of fish in the Hudson River? List at least two reasons why you think it is, or it is not.

This is an improved study but still falls short as it only looks at one location in the river over a slightly longer period of time than your earlier study. We are still missing the data from other areas of the river and other time periods.

e. Scientists are always interested in doing more testing to see if their study is repeatable, or if there might be another explanation for the **findings** (conclusions) in the study. How could you test your results to see if you were right?

>*There are many ways you could test your results to see if they were correct taking into account the answer to the question above. Sampling over a different time period, or a different location are just a couple of ideas in which to test your "finding".*

f. List at least two weaknesses in your study design? What are some ways you could improve the design of this study to be sure you get a **representative sample** of all the types of fish found in the Hudson River?

>*Again there are many ways this study could be improved including sampling over various seasons, weather events, geographic locations, locations that vary in habitat, locations that vary in salinity, sampling with a variety of equipment, from a pier, beach and boat etc.*

Data Source:
Snapshot Data was collected from the snapshot Day website
http://www.ldeo.columbia.edu/edu/k12/snapshotday/Data.htm

Beczak Seining data was collected from the Beczak Environmental Website
http://www.beczak.org/emsystem.htm