NGCSU Lesson Plan

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Standards

State-Based Standards:

From GPS:
Topic: Data Analysis and Probability
MM2D1: Using sample data, students will make informal inferences about population means and standard deviations.

Topic: Process Standards
MM2P1: Students will solve problems (using appropriate technology).
MM2P3: Students will communicate mathematically.
MM2P4: Students will make connections among mathematical ideas and to other disciplines.

From QCC (for backwards compatibility during transition):
Topic: Problem Solving, Reasoning
Standard: Solve problems throughout this course that involve: -selecting appropriate approaches and tools, -using estimating strategies to predict computational results, and -judging reasonableness of results.

Topic: Communication
Standard: Communicates mathematical ideas by using language and symbolism: -reflects upon and clarifies thinking about mathematical ideas and relationships. -formulates mathematical definitions and expresses generalizations discovered throughout investigations. -expresses mathematical ideas both orally and in writing. -interprets written presentations of mathematics, and asks clarifying and extending questions related to mathematics about which they have read or heard.

Topic: Problem Solving
Standard: Uses specific problem-solving strategies such as guess and check; drawing a diagram or other representations of the problem; using tables, charts or graphs; working backwards; using problem reduction (converting to a related problem that is easier to solve); breaking the problem into manageable pieces and solving the separate parts individually; and uses estimation and approximation when appropriate. (Correlated to Algebra I standard 1)

Topic: Problem Solving
Standard: Recognizes and applies the problem-solving process: - Identifies and formulates a problem based on a practical or laboratory situation. - Proposes and evaluates information needed to solve problems based on practical or laboratory situations. - Reaches a valid and supportable conclusion. - Judges the reasonableness of a proposed solution.

Lesson Plan

Unit/Lesson Topic:

Topic Name:	Numeric Sampling
Course Level:	Math 2 (see Lesson Modifications for adaptations to Core Math 3 and Accelerated Math 1)
Content Area:	Mathematics
Type of Lesson:	Lab/Experiential

Understandings: Students will understand that when examining large populations it is not always possible to count or examine every member of the population, and as a result, sampling techniques must be used.

Essential Questions: Can an estimate be made of the size of a population without having to count every member of the population?

How good will the estimate be?

What can be done to make the estimate (sample) better?

Knowledge / Skills: Students will know . . .
- the terms "population," "sample," and "estimation"

Students will be able to . . .
- estimate a population's size based on collected data
- identify the benefits and limitations of population estimation.

Assessment Evidence: Performance Tasks
- monitor progress of students work during the sampling activity
- correct completion of the Data Sheet
- presentation of findings and conclusions to the class

Other Evidence
- quiz (see attached), given to students after the experiment

Learning Plan: Lesson adapted from "How Many Fish Live in My Pond?" by Linda May Posted on the Georgia Learning Connections web site, URL: http://www.glc.k12.ga.us/BuilderV03/lptools/lpshared/lpdisplay.asp?Session_Stamp=&LPID=25048

Time Alloted	Teaching and Learning Strategies
3 min	Tell the students they just moved to a house that has a one-acre pond in the backyard. According to their real estate agent, the pond contains a lot of fish. Since the family enjoys fishing, they want to know how many fish actually live in the pond. Give class opportunity to propose ways that the fish in the pond could be counted. Well, a local fisheries biologist is coming over today with his electrofishing boat to help catch some of the fish. He tells them about a way to estimate the population by capturing only a sample of fish, marking them, releasing the marked fish, and capturing a second sample of fish. This method of estimating the population is more efficient

than fishing with a rod and reel, gill netting, trapping, or draining the pond, as well as less stressful on the fish.

5 min Give each student or group of students a lunch-sized paper bag filled with 167 goldfish crackers (don't tell them how many goldfish are in the bag!), as well as a permanent marker, a pencil, and a data sheet (see Resources). Tell them that the bag represents the one-acre pond, and the crackers inside the bag represent the fish population. The students must estimate how many "fish" are in the "pond" through a process of sampling. Dumping the crackers out of their bags and counting them is not an option ("draining the pond" of the "fish" would be too time consuming, and the extra handling could cause the fish to die).

[use larger groups for CM3 and pairs or individuals for AM1]

8 min Allow the students to "electrofish" for 5 minutes [use electronic timer on the computer] (their hands going into the bag and taking out a cracker represents fish capture by electrofishing). Tell them to capture and mark as many "fish" as they can (one at a time) within the allotted time.

"Fish" should be marked by putting a permanent marker dot on each cracker captured [ask students how they think real fish would be marked] (real marking of fish usually involves attaching a small tag near the dorsal fin). These captured "fish" should be put in a "holding tank" (an area on their desk) until the 5 minutes is up. After counting and recording the number of marked fish on their data sheets, students may release the marked "fish" back into the "pond" (the paper bag).

2 min After putting the marked fish back in the paper bag, [prompt students to see if they can figure out the need for mixing up the bag to represent the swimming of the fish] students should gently mix up the bag's contents (with their hands or by shaking the bag) to represent the random swimming of fish. Then tell the students they are about to perform a second sampling, this time recording the number of marked fish recaptured (m) as well as the number of unmarked fish captured. Unlike the 1st sampling, these "fish" will be released immediately after capture (not put in the "holding tank"). [again, see if the students can figure out the need for mixing] Also, the bag will need to be mixed after each release, to represent the swimming of the fish.

6 min Allow the students to "electrofish" again for 5 minutes. Make sure they don't look in the bag while capturing fish for this second sample (since they wouldn't normally see a tag on a "fish" in a "pond" by looking into the water). Also,

remind the students to tally the numbers of marked versus unmarked fish while conducting this second sample. Remind the students to gently mix up the crackers in the bag between each "capture" since the "fish" will continue swimming during the study.

5 min — Using the data obtained from both samples, have the students estimate the total number of fish in the pond using the Lincoln-Petersen formula given by the fisheries biologist as follows: M/N = m/n where M = the # of animals marked in the whole population, N = the # of animals in the whole population (unknown), m = the # of marked animals that are recaptured, and n = the total # of animals recaptured (marked + unmarked). This formula must be rearranged to isolate N (the estimate of the total # of fish). [remind students to use the Jones Jump-up-and-Down theory while rearranging]

5 min — Have a representative from each group of students take turns announcing their estimates of the "fish population" and enter them into cells on a spreadsheet on the teacher's computer. The spreadsheet will display the average of all the values to get a more accurate overall estimation, and display other statistical values for discussion. Have students guess how many fish are actually in each pond. (Note: 100 seems like to "good" of a number and something students would easily guess at this point. Consider using a less obvious number, e.g. 137; need to track use of this lesson over time to determine if using a smaller or larger number of fish helps or hinders the demonstration and learning process)

[Possible Extension: when using a larger number of small groups, could also explore the use/difference of mean and median and discuss which one might be most useful when trying to get a more accurate count using multiple samples]

5 min — Reveal the true number of "fish" in each "pond" (167 crackers), and compare this value to individual and class estimations. Discuss the benefits and limitations of using the Lincoln-Petersen method to estimate population sizes.

20 min — Evaluate the students' understanding of population estimation with the attached quiz. Answers to the quiz may be found on the second page of the quiz.

Lesson Modifications: (Don't you need to know who the individual students are before you can write this section? Otherwise, it is just a laundry list of possible modifications, trying to anticipate every potential variation in a group of students.)

For other curriculum paths:
Core Math 3: time allotted to perform the activity could be extended to the full class period, to allow greater time for the teacher to circulate and guide the activities; during the next class period, time would be provided for a review, and then the quiz would be given

Accelerated Math 1: students could be asked to compute the average and other statistical values used in Step 7 on their own

Resources

Resources:

1) 1 lunch-sized paper bag filled with 167 goldfish crackers per group of students
2) 1 permanent marker per group of students
3) pencils for recording data and figuring calculations
4) 1 data sheet per group of students with the following headings: # marked in the 1st sample (M), # marked in the 2nd sample (m), # unmarked in the 2nd sample

Lesson Reflection

Analysis of Lesson:

Use this area to reflect on:

- What worked or didn't work
- Why it worked or didn't work
- Which students learned or didn't learn
- Why did they learn or not learn
- What assessment data lead to your conclusions
- If I were to teach this lesson again, what would I do differently