PIONEER RESA EDUCATIONAL TECHNOLOGY TRAINING CENTER

Georgia Framework for INtegrating TECHnology
Phase One: InTech

TECHNOLOGY-CONNECTED LESSON PLAN

Lesson Plan Number	4

(please type)

Name:	James O'Connor	**School:**	None (student at NGCSU)

Lesson Title:	How Many Fish Are In My Pond?
Grade Level/Subject Area:	HS / Statistics (taught to an Intro to Statistics class of mostly seniors at North Forsyth High School)
Student Profile:	**Number of Students:** 8
	Number of Students with Special Needs: 0
	Area of Specialties: n/a
Performance Objectives:	Students will be able to . . . - design an experiment based on a real-world problem - estimate a population's size based on collected data - identify the benefits and limitations of an experiment's design - recognize the need to use simulation to carry out an experiment - identify the benefits and limitations of a simulation's design to teacher satisfaction. Students will demonstrate knowledge of the above by completing a quiz with 80% accuracy.
Curricular Connections: (QCC/IEP/Local or National Standards)	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.
Assessment:	**Student Self-Assessment Rubric:** X **Teacher Student-Assessment Rubric:** X
Technology Connections:	Use a computer-based simulation of the "fishing" method. Using an Excel spreadsheet to summarize and analyze the collected data.
Materials:	Computers with Internet access and Excel - one with a projector attached Paper bags with 230 goldfish crackers Markers (3 different colors) Worksheet for recording the results
Related URLs:	http://oconnorclass.com/simulation.htm

Procedures:

Whole Group:
I have a problem. I'm thinking about buying some land with a 1-acre pond on it, and the seller is telling me the price should be based on how many fish are in the pond. He found some fishing enthusiast web site that provided the following table:

Number of fish	additional value of property
0 – 50	1%
51-100	2%
101-150	3%
151-200	4%
201-250	5%
251-300	6%
301-350	7%
351+	8%

So, before I decide to buy the property, I think I'd like to know how many fish are in the pond.

Draw a picture of a pond on the board, and get class to suggest different ways they might count the fish. Since "sampling" was a previously studied topic, work concepts of sampling into the discussion. If students don't get there on their own, lead them into the Lincoln-Petersen formula method of capture/mark, recapture/examine.

Remind the students of the three aspects of experimental design: control, randomization, and replication, and discuss how they can be applied to the experiment we're designing.

Once the Lincoln-Petersen method of counting in settled on, talk about how the fishing needs to be done. Again, work in concepts from sampling, such as different forms of bias. Eventually, get to using the "electrofishing" method for the capturing.

OK – this looks like a reasonable way to count the fish to me, but before I pay a guy to bring out his electrofishing boat to count my fish, I'd like more evidence of whether this will work, and how accurate it would be (after all, each increment of 50 fish is going to cost me another 1% on the price of the land). How can I test this?

Get the class to suggest different methods to simulate the electro fishing. Make sure that for each method considered, the three aspects of experimental design are considered. If the students don't get there on their own, lead the discussion to a "physical" simulation (drawing objects out of a container) and a "computer" simulation (where the fish are represented by random numbers generated by the computer).

Small Group:
Small groups of students will perform the "physical" simulation using the following steps. Since the physical simulation is going to be

repeated 3 times, be sure to tell them to mark the tail of the fish the first time, the middle of the fish the second time, and the nose of the fish the third time. Three different colored markers can also be used, and rotate the markers each time, so each group uses a different color each time.

Give each student or group of students a lunch-sized paper bag filled with 230 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).

Allow the students to "electrofish" for 1 minute [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).

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 (u) 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.

Allow the students to "electrofish" again for 1 minute. 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.

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). Repeat the fishing activity two more times, with group member rotation as specified on the data sheet. For the second time, use 1.5 minutes for the time, and for the 3^{rd} use 2 minutes. --- After all 3 iterations of the physical and computer simulations have been done, pass out the "questions" page, and have each group work on the tasks and answer the questions on the sheet. Allow 10-15 minutes for the students to build the spreadsheet and come up with their answers. Have each group display their Excel spreadsheet using the computer with a projector, and explain their conclusions to the class
	Individual: While the students doing the physical simulation are getting ready, the students doing the computer simulation will go to the URL: http://oconnorclass.com/simulation.htm They should click the "Reset Simulation" link to make sure the simulation is ready to go. Then, when the timer is started for everyone to do the "capture and mark" step, the students should click the "Fish and Mark" link repeatedly. The screen will update with the count of fish that have been captured and marked. When the timer is started for everyone to do the "capture and examine" step, the students should click the "Fish and Examine" link repeatedly. The screen will update with the number of fish that were marked and unmarked. At the end of the second step, the students will report the numbers from the simulation program back to the "recorder" in their group to go on the data sheet.
Classroom Management:	**Technology Management:** used the Java-based timer program to time the simulation steps
	Instructional Groups: groups were selected so that the top students in the class would be in separate groups; 3 members were assigned to each group so that each member would perform each of the three tasks during the 3 cycles of the simulation