Go Fish[1]

Math Abilities

Conceptual Understanding

Data Collection
Interpret Data
Proportional Reasoning

Procedural Knowledge

Solve Proportions

Process Standards

Problem Solving
Reasoning
Communication
Connections
Representation

Hook

Imagine that you are asked to determine the number of fish in a nearby pond. To count the fish one by one, you could remove the fish from the pond and stack them to one side, or mark each fish so you would not count them over and over again. Counting like this could be hazardous to a fish's health!

To determine the number of animals in a population, scientists often use the *capture-recapture* method. A number of animals are captured, carefully tagged, and returned to their native habitat. Then a second group of animals is captured and counted, and the number of tagged animals is noted. Scientists then use proportions to estimate the number in the entire population.

Group Arrangement

Students work in groups of three to four.

Each group needs:

- 1 paper lunch sack - represents the "lake"
- A supply of goldfish crackers - represent the "fish" in the lake
- A supply of pretzel fish crackers - represent the "tagged fish"
- 1 styrofoam cup - represents the "net"
- 1 paper plate

A. Collect the Data

Capture:

1. Each team receives a paper lunch bag with goldfish crackers inside.
2. With the "net," scoop a sample of goldfish out of your "lake" onto the paper plate.
3. Replace your sample of goldfish with pretzel fish. These are your "tagged" fish.
4. Count the number of "tagged" (pretzel) fish and then return them to the bag.
5. There are _____ tagged fish in the entire lake.

Recapture:

Shake the bag gently.

For the first casting, use your net (cup) to remove a sample of fish. Count the number of "tagged" (pretzel) fish in your sample and record the total in the first column below.

Return all of these fish to the lake (bag) and shake gently to mix them up.

Repeat this process until you have gathered information on 10 samples and filled in the table below.

Sample Number	Number of Tagged Fish in Sample	Total Number of Fish from Sample
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Average		

B. Analyze the Data

1. To find the AVERAGE number of tagged fish, add up all 10 samples of the tagged fish and divide by 10. Do the same thing to find the AVERAGE number of total fish in your samples. (Using the AVERAGE number with 10 samples is more reliable than using any one sample's data.)

2. Use the proportion below to estimate the total number of fish in your lake:

$$\frac{\text{Average \# tagged in samples}}{\text{Average \# in samples}} = \frac{\text{Total \# tagged in lake}}{\text{Total \# fish in lake}}$$

3. ESTIMATED POPULATION: _____

4. Now count the total number of fish in your lake to determine how close your estimate from the "sampling" is to the actual number of fish in the lake.

   ACTUAL POPULATION: _____

How close were you to the actual number of fish?

Math Connection

As a result of this activity, students learn how to gather information about a large population based on a representative sample whose makeup is similar.

Assessment

1. Where else would scientists use this capture/recapture method?
2. What are some of the factors that could have caused an estimate to be close or not so close to the actual number of fish?

[1] Lesson plan adapted from http://fcit.usf.edu/FCAT8m/resource/default.htm

Go Fish

There will be vocabulary discussed in this assignment that you will need to be familiar with before you begin and as you perform the tasks in the experiment. Please do not eat any of the fish in the lake as this will skew the data that we collect. You may eat the goldfish AFTER we are finished with the experiment. I will let you know when you may eat your goldfish.

Term	Meaning
1. Net	1. Dixie cup
2. Cheddar goldfish	2. Untagged fish
3. Pretzel goldfish	3. Tagged (Marked) goldfish
4. Lake	4. Paper bag

I. Collect the initial data

A. Capture:

1. With the net, scoop a sample of goldfish out of your lake onto the paper plate.
2. Replace the sample of goldfish with pretzel fish. These are your tagged or marked fish.
3. Count the number of tagged or marked fish and return them to the lake.
4. There are _____ tagged fish in the entire lake.

B. Recapture:

1. Shake the bag GENTLY as to not damage any of the fish in the lake.
2. For the first casting, use your net to remove a sample of fish. Count the number of total fish and record this in the column named "Total fish in sample".
3. Count the number of marked fish in the sample and record this number in the column named "Total tagged fish in sample".
4. Use the formula for proportions to find the estimate of the population of fish in the lake.
5. Return all fish to the lake and repeat steps 1-4 until you have 10 trials.

C. Analyze the data:

1. To find the average number of tagged fish, add up all 10 samples of the tagged fish and divide by 10. Do the same thing to find the average mumber of total fish in your samples. (Using the average number with 10 samples is more reliable than using any one sample's data.)
2. Use the proportion for averages to get a better estimate of the total population
3. The estimated population from the averaged samples is _____
4. Now count the total number of fish in your lake to determine how close the estimates are from sampling to the actual number of fish in the lake.
5. The actual population of the fish in the lake is _____
6. How close were you to the actual number of fish?

D. Extensions:

1. Discuss with your group another experiment where scientists may use the capture/recapture method for finding population size.

2. Can you think of any shortcomings this experiment may present for scientists in the field? Consider what things are not controlled in nature and list 3 concerns that a scientist in the field may have when performing this experiment.

3. Research an experiment online and report the findings of an experiment in which the capture/recapture method was used.

- Prediction for the Population of Fish in the Lake

$$\frac{TIS}{n} = \frac{TIL}{N}$$

- Where **TIS** stands for Tagged in Sample, **n** is the number in the sample, **TIL** is tagged in lake and **N** is the population of the fish in the lake (this is the variable for which we will be solving).

Sample Number	Number of Tagged Fish in the Sample	Number of Total Fish in the Sample	Prediction for the Population of Fish in the Lake
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

A	Average of Tagged Fish in each Sample	Average of Total Fish in each Sample

- New Formula for more accurate results

$$\frac{AOM}{AOS} = \frac{MIL}{N},$$

- Where **AOM** is the average of the marked fish in the samples, **AOS** is the average of 10 samples, **MIL** is the number of fish marked in the lake and **N** still stands for the population of fish in the lake.

The more accurate prediction is _____

How close is this prediction to the actual (counted amount) of total fish in the lake?