Inquiry Question

How do scientists estimate the number of fish in a lake? There's no way that they can count them all!

Name: _____ **Date:** _____

In order to make decisions and recommend environmental policies, scientists are regularly asked to make estimates on the populations of animals in various regions of our country.

For example, a scientist may be asked to estimate the number of fish in a given lake. This lake may be a huge lake, where the number of fish may be in the millions.

In this project you will learn a technique to be able to calculate this using a real-world technique commonly used by wildlife personnel.

It consists of netting, marking, and releasing X number of fish. The marked fish are then given a period of time to disperse throughout the unmarked population. After a given period of time a new sample of size X is netted and the marked fish are counted. The idea of this project is to mathematically work out how many fish are in a lake using a math model.

General Instructions

The method for estimating the number of fish in a lake that we'll be using involves catching fish, tagging them, then returning them into their population. Given enough time, we assume that the tagged fish mix in with the other fish and we can begin collecting samples for estimating.

Materials you'll need:

- 1 large bag of white beads (300)
- 1 small bag with between 15 and 40 red beads
- 1 jar or bowl

Tagging Fish:

- The white beads represent untagged fish in the lake.
- The red beads represent fish that we've tagged in the lake.
- In the picture below, the fish has a tag (green) in its dorsal fin.

Project submission:

You can either submit photos/video of your project, along with your answers to the questions on the following pages. Your photos/video should show you and your set-up during the experimentation.

The Estimation Method!

Step 1: Pour all the white beads in the bowl. These beads each represent a fish that lives in the lake.

Why are there no red beads at this point?

_____

Variable: Let **N** = number of fish in the lake

Step 2: Let's take a sample of fish from the lake (Sample #1).

- Count out a number of beads from the bowl (anywhere between 30-60).
- Variable: Let **S** = number of fish in the sample = _____.

Step 3: Time to tag and return our fish to the lake.

- Replace the number of beads from our sample #1 (S) with red beads.
- This represents: _____
- Put the red beads into the bowl.
- This represents: _____
- Mix the bowl so the red beads are mixed in with the white.
- This represents: _____

Step 4: After some time, we return and take another sample of fish from the lake (Sample #2).

- Randomly remove **S** beads from the bowl (could use a blindfold).
- This represents: _____
- Count the red beads from your sample (T)
- These represent: _____
- Document both S and T in the table below for this sample.
- Dump your sample back into the bowl and mix again.
- This represents: _____
- Redo Step 4 three more times, for samples 3-5 and document your numbers in the table.

Table.

Sample	S	T	Ratio of T/S	N
2				
3				
4				
5				

Step 5: Calculate the ration of T/S for each sample and document in the table.

What does this represent?

Are the ratios pretty similar? Why would this be true?

What might cause the ratios to be really different?

Step 6: Calculate the estimated number of fish in the lake (N) for each sample and document in the table.

Can you think of why T/S should be approximately equal to S/N? This is a tough question to try to answer, but do your best.

Using T/S = S/N, determine N for each sample and put it in the table.

Here's an example calculation if T=4 and S=45:

$$T/S = S/N$$
$$4/45 = 0.089$$
$$0.089 = 45/N$$
$$N \times 0.089 = 45$$
$$N = 45/0.089$$
$$N = 595$$

Show your work for each N calculation below:

Step 7: Calculate the average of your four samples for N.

N_{ave} = _____+_____+_____+_____ / 4 = _____

How many white beads did you start with? _____

How does the real number compare to your estimations in your samples? _____

If it was impossible to count the number you started with, was this a good way to come up with an estimation? Provide 5 other examples of where it would be really tough to estimate a population.

Step 8: What situations could really mess-up your calculations? Give 3 examples.

Step 9: Submit your work and photos/video to your teacher.