Name: _____

There's Enough Food for All

Day 1: How Long Will You Wait?

When you go to the supermarket, how would you choose a checkout line if all you want is to get done quickly?

Shortest Line or a short line with people who have the least amount of items

If there are a few equally good food patches to feed from, how would an animal choose a patch if it is alone? How would it choose a patch when there are other animals also feeding in these patches?

If alone it will choose a patch that has the most amount of food, a patch with the best quality food, the closest patch, etc. If in a group it will matter not only how much food is in a patch but also how many animals are in the patch.

If the animal is feeding in a patch with lots of food and the patch starts getting crowded, should it move to another close-by patch which has less food but is also less crowded? Why/Why not?

It should move to a new patch if the number of animals in the first patch starts increasing. If the new patch has less food but also fewer other animals, it might still mean more food for itself.

Experiment 1:

Method:
Jelly beans will be dispensed in two separate lines, at rates specific to each line, and students will act as foragers foraging for these food items. Students are to start in the middle of the room and choose whichever line they see fit. Each student is allowed to take 1 jelly bean at a time and place it in a bowl. Each student can then get back into whichever line they decide. Every 30 seconds all students would freeze and the number of students in each line will be recorded. The experiment will continue for 10 minutes.

Have one adult record the number of children on one side of the room every 30 seconds after asking them to freeze in their current position. The students can fill in the numbers on each side after the experiment is done (number for the side not recorded = total number of students minus the number recorded for one side).

The children are not to be told about the rate at which the jellybeans are being dispensed on both sides and see if they can distribute themselves according to the ratio.

The children should be instructed to move between the two feeding stations at normal pace

Make sure no one is cutting into the lines

Make sure there is enough room for the kids to line up so that the two lines do not run into each other

It is important that the children stay at whichever side of the room they were in when the "freeze: occurs

It is helpful to set up a stopwatch that beeps when one should hand out a jellybean

Materials:
- Jelly beans
- Bowls
- Timer

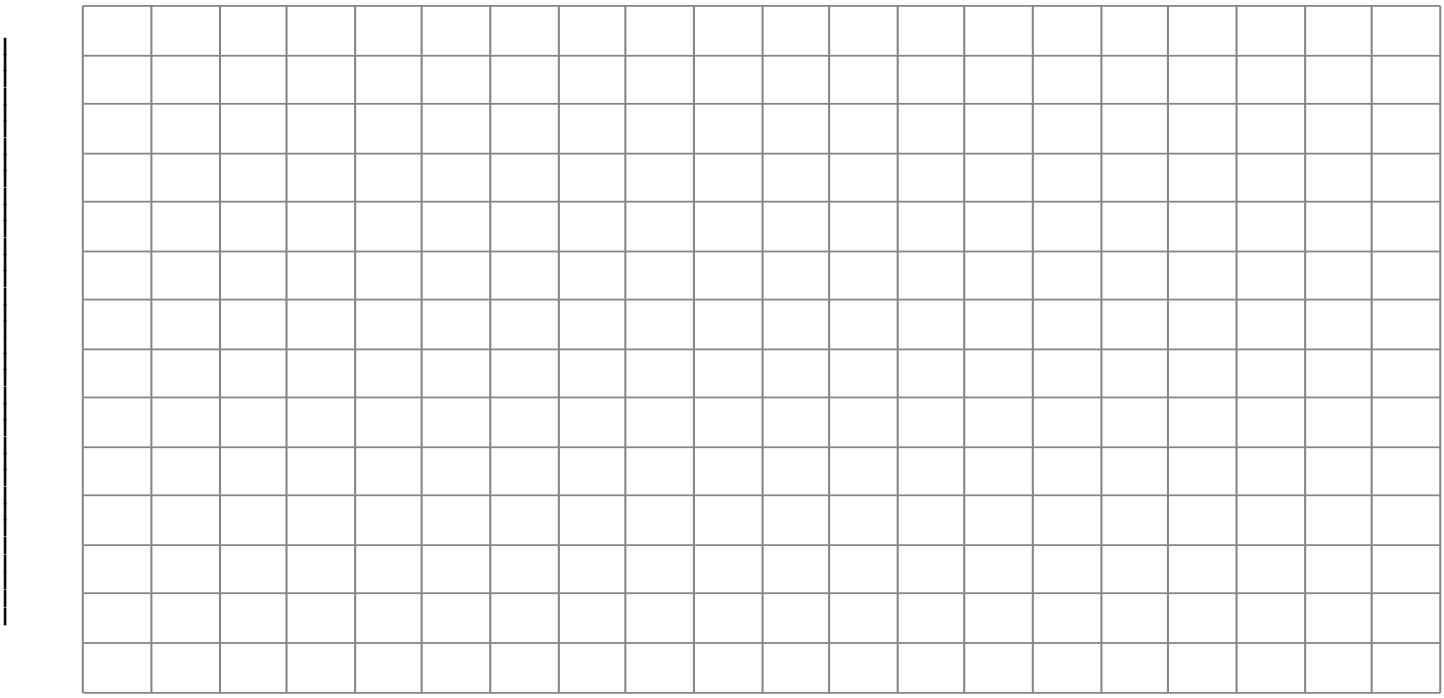
Number of Foragers on Left	Number of Foragers on Right

Number of Foragers on Left	Number of Foragers on Right

1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Title_____**y axis: # of Foragers on a given side, X axis: Time**



For graphing have the number on two different sides represented by two different colors with a legend. This will help them visualize the results better.

What do you think was the ratio between the two rates at which jellybeans were dispensed in the two lines?

Example: If a jellybean was dispensed every 2 seconds on one side and every 8 seconds on the other side or something equivalent, then the ratio was 1:4.

How important it is for you to be able to get a good look at the two lines for making a good decision about which line to join?
Very important because the lengths of the two lines and the speed with which they are moving tell you how quickly you can get to the feeding station in each line.

Define being:

Informed: **Having knowledge of a particular situation**

Uninformed: **Not informed or lacking knowledge of a situation**

What determined which line you chose? How would this have been different if you were by yourself?

Line length, how fast line was moving etc. If you were by yourself you would have chosen the line based only on which of the two was dispensing food at the faster rate, without having to worry about how many others are there in that line.

Experiment 2:

Method:

Jelly beans will be dispensed in two lines, at an equal rate. Students are to start in the middle of the room and choose whichever line they see fit. Students are allowed to take 1 jelly bean if they are "small" (wearing hats of one type) and 4 jelly beans if they are "large" (wearing hats of a different type) and place it in bowl. Students can then get back into whichever line they choose. Every 30 seconds all students would freeze and the number of students in each line will be recorded. The experiment will continue for 10 minutes.

1:4 ratio- 13 big and 13 small (if 26 students adjust as needed)

Materials:

- Jelly Beans
- Bowls
- Timer
- Party hats

Make sure that they stay at each station for the correct number of jellybeans. For example the kids that are big animals need to stay there for four beeps.

Compared to the previous experiment, what do you think will happen when different animals can eat different amounts?

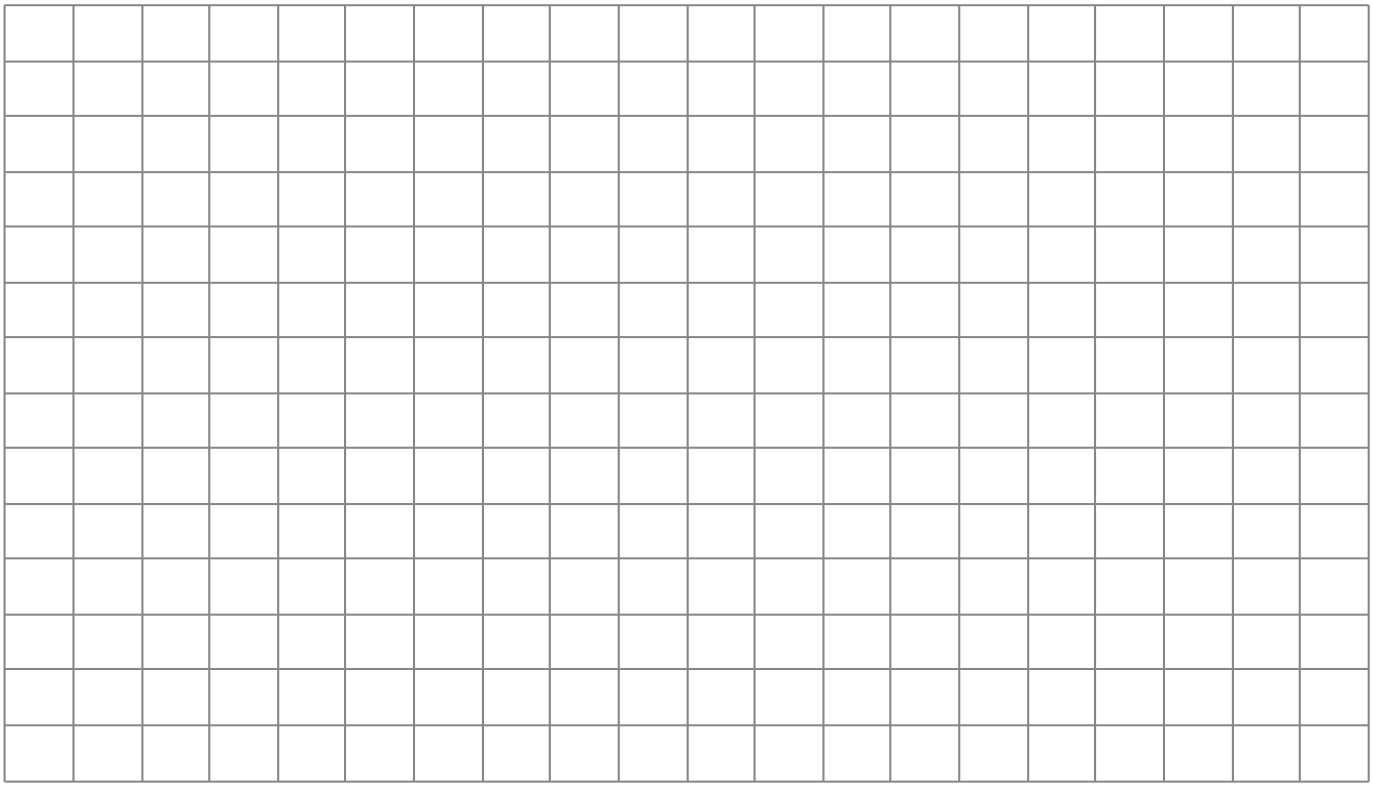
The little "fish" are going to want to look at how many big "fish" are in a given line and how fast the line is moving to determine which line they will be able to get food from faster.

Have one of the adults record the number of children on one side of the room every 30 seconds after asking them to freeze in their current position. In this experiment they need to write how many big and how many small are there on each side; then when the students calculate it they need to count big fish as 4 and small fish as 1 and then total that up to get the number on the left and number on the right.

	Number of People on Left	Number of People on Right
.5 min		
1 min		
1.5 min		
2 min		
2.5 min		
3 min		
3.5 min		
4 min		
4.5 min		
5 min		

	Number of People on Left	Number of People on Right
5.5 min		
6 min		
6.5 min		
7 min		
7.5 min		
8 min		
8.5 min		
9 min		
9.5 min		
10 min		

Title_____ **y axis # of kids on given side: X axis is time ____**



For graphing have the two different sides represented by two different colors with a legend. This will help them be able to visualize the results better.

What determined which line you got food from?
How fast the line was moving and how many "big" animals were in that patch

How could this be seen in the wild?
This could be seen with young and adults are eating from the same patch. Or any smaller animal vs larger animal

Question for next time:
What issues you think you would have to account for if you were doing this experiment with real animals, say fish?
Real animal might not be hungry, reduce disturbance, .etc

Day 2: Something's Fishy Part I

It is important to go over the instructions very carefully and if there is an extra tank of fish, it is a good idea to show an example run of how to collect data.

Fish

- **Obtain fish from a pet store and set up tanks; the type of fish will determine how the set-up takes place.**
  - **You will want to do this a week before the experiment in order to ensure that the fish are not sick**
  - **If a fish dies most pet stores will allow you to return the fish in exchange for a new one**
- **Feed the fish from both the left and right side of the tank for a week before the experiment. This will allow the fish to get accustomed to food coming from both sides.**

Set up the tanks where they will be during the experiment. Let the fish adjust for about 15-30 minutes

It is important to warn the children to be quiet and to not hit the tables that the fish tanks are sitting on as this will frighten the fish and may mess up the experiment.

We use something called a blind in order to make sure the fish were not frightened by movement

Method:
Students will be divided into groups of ~5 depending on their number as well as the number of help available. Each group will receive 2 tanks of zebrafish; with the Left and Right halves marked. Every 30 seconds students will feed a given amount of brine shrimp to each side of the tank and after 5 seconds of feeding record how many zebrafish are on each side of the tank. Each trial will last 5 minutes and would be repeated twice with two different ratios of food input.

It is important that the observer only look at one side of the tank to reduce any confusion about how many fish are there on each side. When the experiment is over, they can then calculate how many fish were on the side that they did not observe. The first experiment should be a 1:1 ratio and done with an even number of fish for the calculations to be easier. One can try a harder ratio in the next experiment. There is a second table with a graph after the graph and questions for the first experiment, which allows them to calculate the class average for the data and for them to see that the more replicates you do the better are the results. Shows why scientists repeat an experiment multiple times to get the most accurate results.

Materials
- Zebrafish
- Live brine shrimp (any type of food will work), measured in small vials- **You can buy them from any pet store. Drain all water out and measure. Then make different dilutions to obtain a specific ratio.**
- Tanks
- Timer
- Tape to divide the tank in half

Make sure that you know the difference between the two containers with the food (mark them with different colors), since they will make the different ratios

Ratio Left **1 : Right 1 -** **The ratios you want to test can be based on the number of fish that are in there each tank. Examples: With 3 fishes, one can do a 1:2 ratio. The more fish, the more possibilities there are. In our version of the experiments on day 2, Experiment #1 had 4 fish and Experiment #2 had 5.**

How do you think the ratio will affect how the zebrafish spread themselves out?
The Zebrafish should spread out according to the ratio of food. Ratio of fish should be the same as the food.

Tasks:

_____: Timer

_____: Recorder

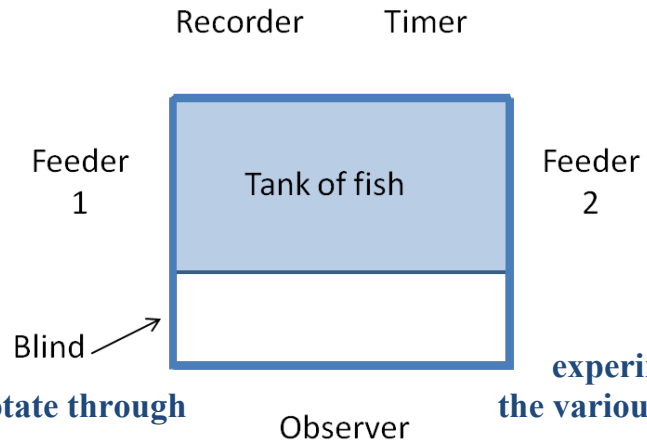
_____ : Feeder R

_____: Observer

_____: Feeder L

Observer should look at the number of fish on ONLY one side and then calculate how many should be on the other side after the experiment is done

Position the kids around the tank in the following fashion so as to least disturb the fish- the only one in front of the tank should be the observer



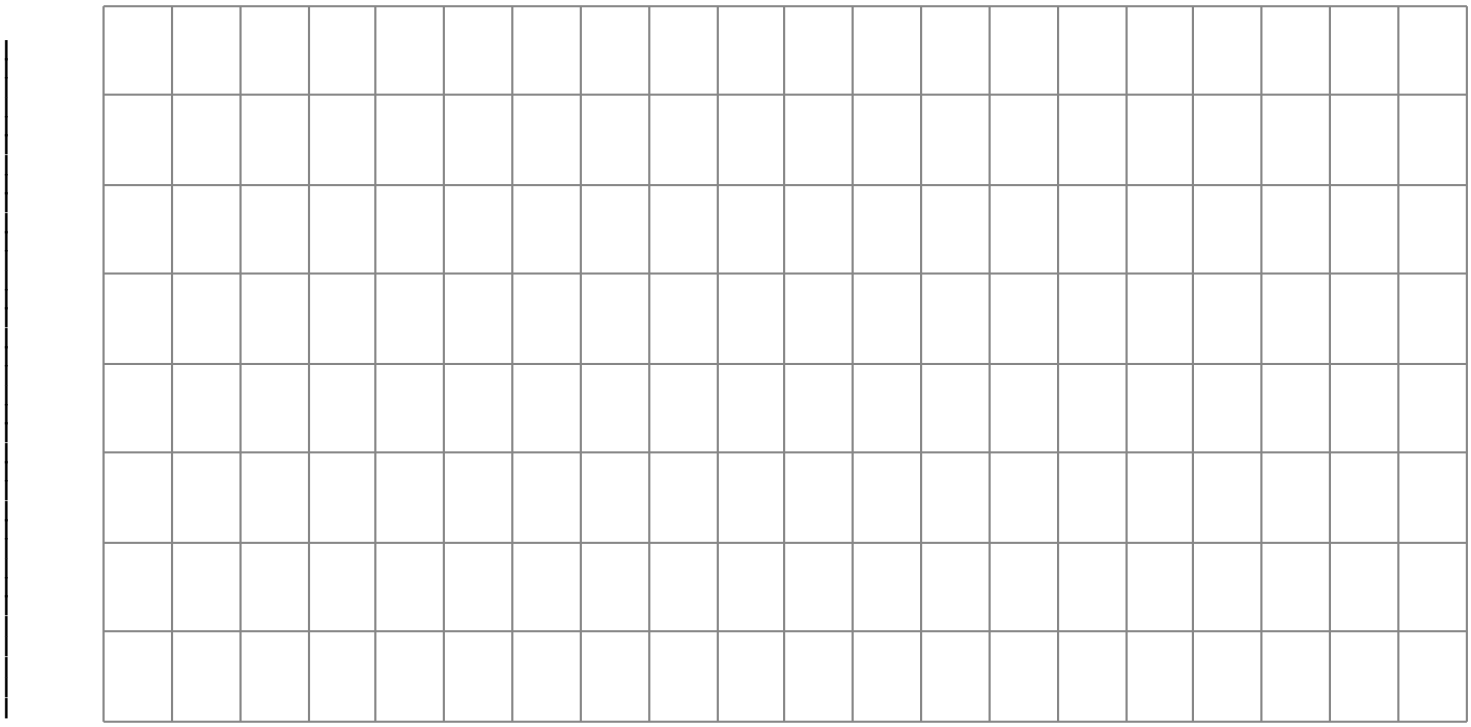
Since the experiment is done three times, students can rotate through the various jobs

Timer should count down from 5 as the time approaches to feed so the feeders are ready to read and and then count up to 5 after feeding before the observer takes the count of fish.

	Number of Fish on Left	Number of Fish on Right
.5 min		
1 min		
1.5 min		
2 min		
2.5 min		

	Number of Fish on Left	Number of Fish on Right
3 min		
3.5 min		
4 min		
4.5 min		
5 min		

Title _____

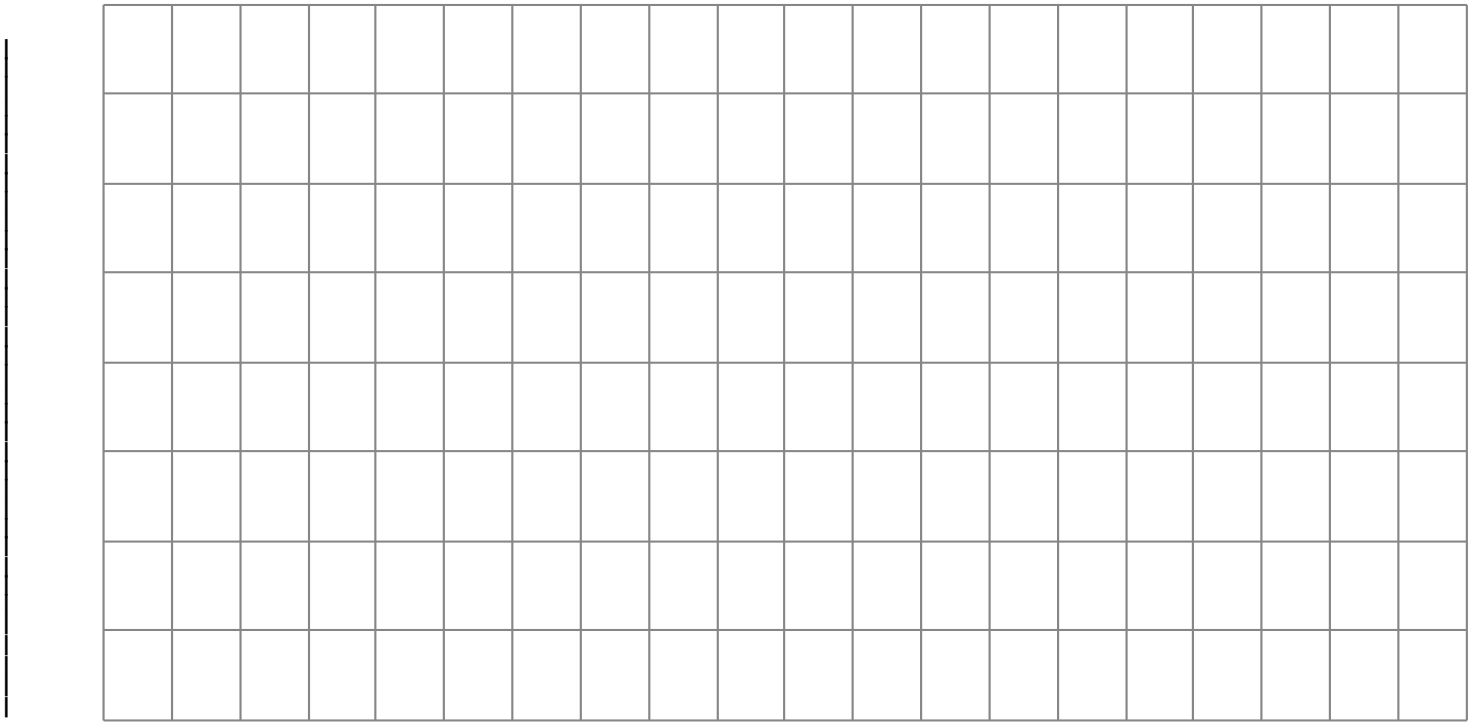


Is the observed data similar to what is expected (given by the bold line in the graph)? If it is not, what do you think is going on?

They should be comparing the solid line to what they observed, they should notice that the fish as time progesses will better match the ratio, since it takes time for them to figure out the ratio.

	# of Fish on Left	#of Fish on Right		# of Fish on Left	# of Fish on Right
.5 min			3 min		
1 min			3.5 min		
1.5 min			4 min		
2 min			4.5 min		
2.5 min			5 min		

Title:_____



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Are your results closer to the expected ratio than others? If so why do you think this is?

Tank 2: **Make sure that you know the difference between the two containers with the food, since they will create the ratio**

Ratio: L_**2**_____:____R__**3**__

Tasks:

_____: Timer

_____ : Feeder R

_____: Feeder L

_____: Recorder

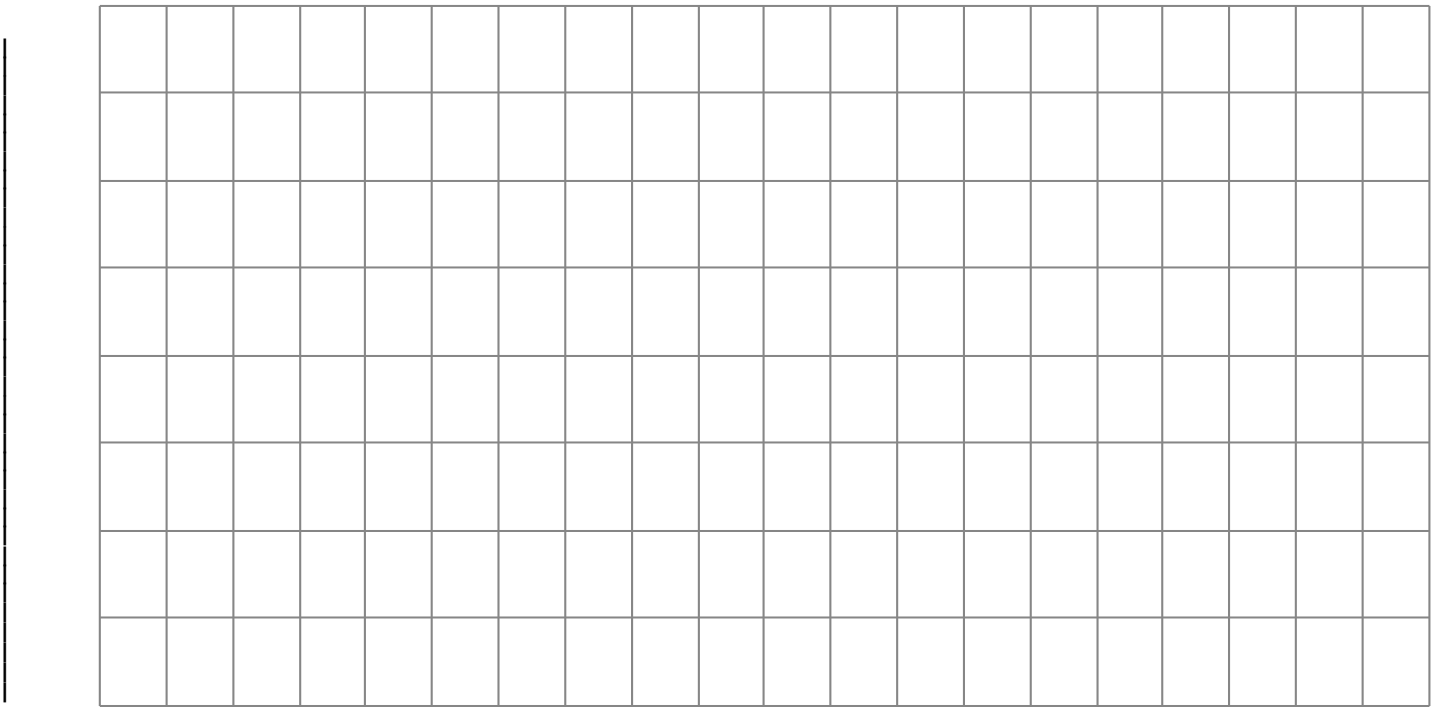
_____: Observer

Observer should look at the number of fish on ONLY one side and then after the experiment is done calculate how many should be on the other

	Number of Fish on Left	Number of Fish on Right
.5 min		
1 min		
1.5 min		
2 min		
2.5 min		

	Number of Fish on Left	Number of Fish on Right
3 min		
3.5 min		
4 min		
4.5 min		
5 min		

Title _____



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Based on the number of fish on each side what do you think the ratio was?
Have them look at the graph to get this answer, it should be 2:3

What are the advantages of the fish spreading themselves out in this fashion?
Everyone gets the most amount of food this way.

Question for next time: What will happen when the food input into either side is switched with each other?
The fish should follow the ratio so if the amount of food switches then the number of fish on each side should also flip.

Day 3: Something's Fishy Part II

Method:

Students will be divided into groups of either 4-5 students per group. Each group will receive a tank of zebrafish; with the Left and Right halves marked. Every 30 seconds students will feed a given amount of brine shrimp to each side of the tank and record how many zebrafish are on each side of the tank. After 5 minutes the amount being fed in each side will be switched. Each trial will last 10 minutes.

Materials

- Zebrafish (any small fish should work)
- Live brine shrimp (any type of food should work)
- Tanks
- Small containers containing the given amount of food
- Timer
- Tape to divide the tank in half

Tasks:

_____: Timer

_____ : Feeder R

_____: Feeder L

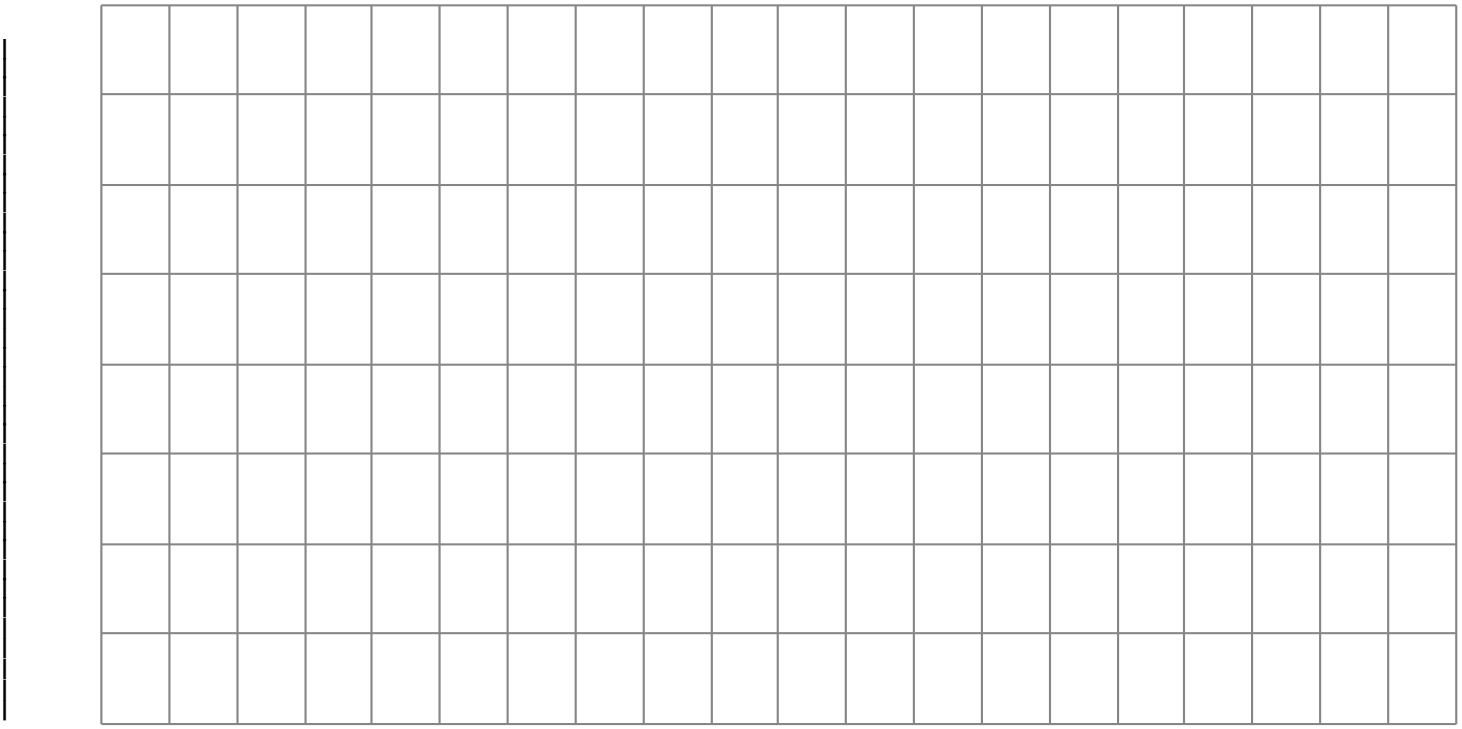
_____: Recorder

_____: Observer

	Number of Fish on Left	Number of Fish on Right
.5 min		
1 min		
1.5 min		
2 min		
2.5 min		
3 min		
3.5 min		
4 min		
4.5 min		
5 min		

	Number of Fish on Left	Number of Fish on Right
5.5 min		
6 min		
6.5 min		
7 min		
7.5 min		
8 min		
8.5 min		
9 min		
9.5 min		
10 min		

Title _____



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What happened when the amount fed on each side switches?

It will depend on the data but what should be seen is that the fish switch around to match the amount of food distributed on each side.

The purpose of the next page is to see if the students grasped the concepts that are being demonstrated with this exercise. It is good to give this questionnaire both before the exercise and 2-3 days of completing it. Comparing their performance on the helps one to evaluate the effectiveness of the exercise. Correct answers are highlighted.

Name:_____

All New Explorers Must Answer a Science Question

1. When at the checkout of a grocery store, what is the most important thing(s) that should determine which line you get in if you want to get out of there fast?
    A. Length of the line
    B. How many groceries people have
    C. How friendly the cashier is
    D. All the above
    E. A and B

2. What is the most important thing (s) that animals need to know when it comes to a specific food source?
    A. How many animals are already at that food source
    B. How much food there is at the source
    C. If the animal knows the other animals there
    D. All the above
    E. A and B

3. Why do older animals know where to find the best food?
    A. They just know
    B. They are stronger
    C. They have experience
    D. Chance
    E. They really do not know

4. Why is the size of other animals around you important when it comes to eating?
    A. You are smaller so you eat more to grow bigger
    B. Bigger animals eat more causing less food being left for others
    C. It does not matter because everyone shares
    D. All the above
    E. A and B

What did you take away from these three days of experiment?

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_____