

Name _____

Date _____

How much turbidity is too much?

Before you begin: Develop a hypothesis that predicts at what concentration of turbidity you think an aquatic animal will begin to demonstrate a response.

Based on the information in the “Relational Trends of Fresh Water Fish Activity”, I expect that the aquatic organisms may start to be affected in a few hours around 8-10 NTUs, and that they will die in a few weeks if the levels reach above 1,000 NTUs. This also depends on the amount of time they are left in the turbid water.

Materials:

- 7 pint jars per group
- Pond water (enough for 500 mL per jar)
- Liquid bentonite
- 1 mL eyedropper
- Turbidity meter
- Zooplankton (recommended: *Daphnia magna*)

Preparation:

- a. Add 500 mL of pond water to each jar.
- b. Measure out the required amount of bentonite (which simulates turbid water) using the eye dropper, and add to the jar with water. Stir the jar.

solution #	Amount of bentonite	Turbidity (NTUs) – <i>provided as a reference only; each experiment will be slightly different due to pond water differences</i>	YOUR turbidity values
1	0	6.6	
2	0.5 mL	57.1	
3	1 mL	81.3	
4	2 mL	108	
5	3 mL	164.6	
6	4 mL	240	
7	5 mL	670 (max of our probe)	

- c. Add 5 young *Daphnia magna* to each jar. Make sure they don't have eggs.
- d. At least once a day, cap the jars and shake them to stir up the bentonite. Monitor the animals over the next 3 days, checking at least once a day. Remove any dead animals as well as the molt castings from the container.

Data: Record the number of animals that are dead each day for the next 3 days.

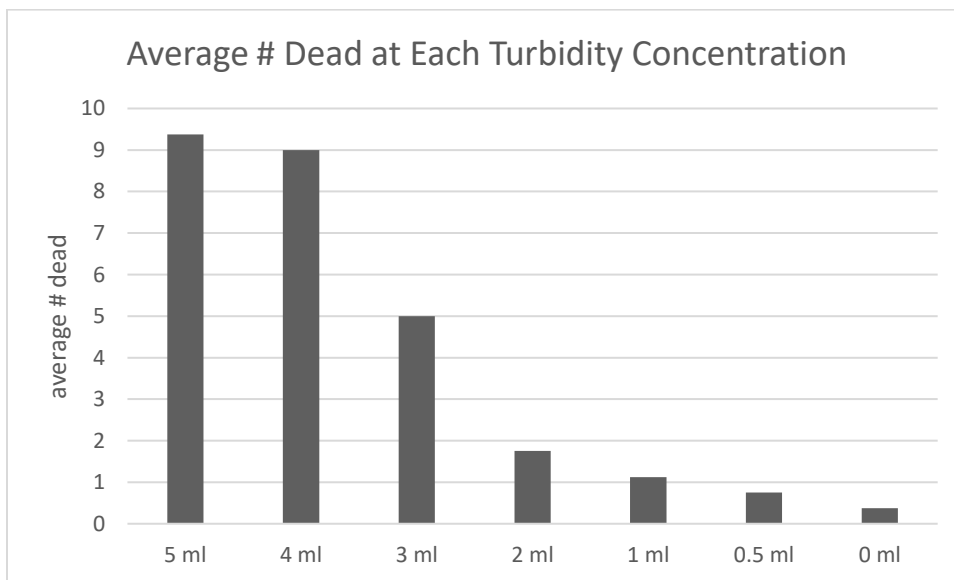
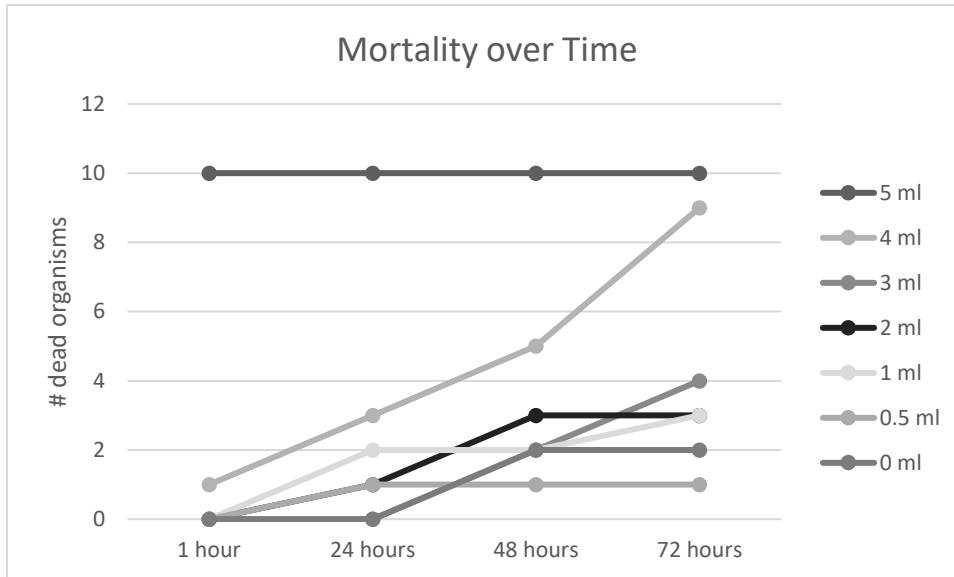
DATA TABLE – *example data only*

Amount of bentonite	# dead after 1 hour	# dead after 24 hours	# dead after 48 hours	# dead after 72 hours	Average # dead
0	0	0	2	2	2
0.5 mL	0	1	1	1	2
1 mL	0	2	2	3	3
2 mL	0	1	3	3	6
3 mL	0	0	2	4	5
4 mL	1	3	5	9	10
5 mL	10	10	10	10	10

Class Average: Compare your data with your classmates' data. How many organisms were dead after 3 days at each concentration?

	0	0.5 mL	1 mL	2 mL	3 mL	4 mL	5 mL
Group 1	1	1	2	3	9	9	10
Group 2	0	0	1	2	8	9	10
Group 3	2	1	2	1	4	8	9
Group 4	0	1	1	1	3	9	9
Group 5	0	1	1	2	3	9	10
Group 6	0	0	0	1	7	10	10
Group 7	0	1	2	3	4	9	9
Group 8	0	1	0	1	2	9	8
Average	0.375	0.75	1.125	1.75	5	9	9.4

Make two graphs; one showing the change in survival over time, and a second showing the total number of surviving animals after 3 days, based on your class averages.



Note: if students used Excel to graph their data, they can try adding error bars (after calculating the standard error).

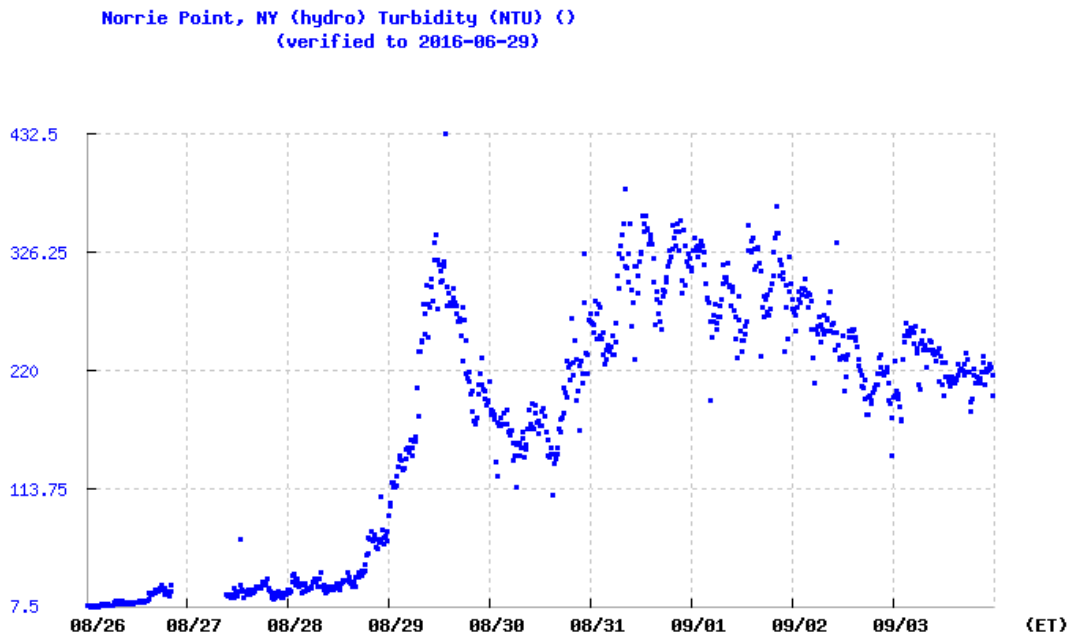
Analysis:

1. Looking at your individual group data, do you notice any trends?
Students may have noticed that more of the organisms died at higher concentrations of turbidity.
2. Looking at your individual group data, are there any data that don't make sense, or did something happen that was different from what you anticipated? If so, try to explain why these data are different from your expectations.
Student answers will vary.
3. Using the class data, at what concentration(s) were the organisms affected immediately?
5 ml
4. Using the class data, at what concentration(s) did the greatest number of organisms die?
5 ml
5. **Why** are organisms affected when they are exposed to too much turbidity?
Organisms are affected by turbidity in a number of ways – it reduces their ability to breathe, it changes the way they can find food, it may affect their feeding, and it may reduce the amount of food available to them by reducing light and thereby affect plant/protist growth.
6. What kind of graph did you make for your averaged class data? *Most students will likely make a bar graph.*
7. Why?

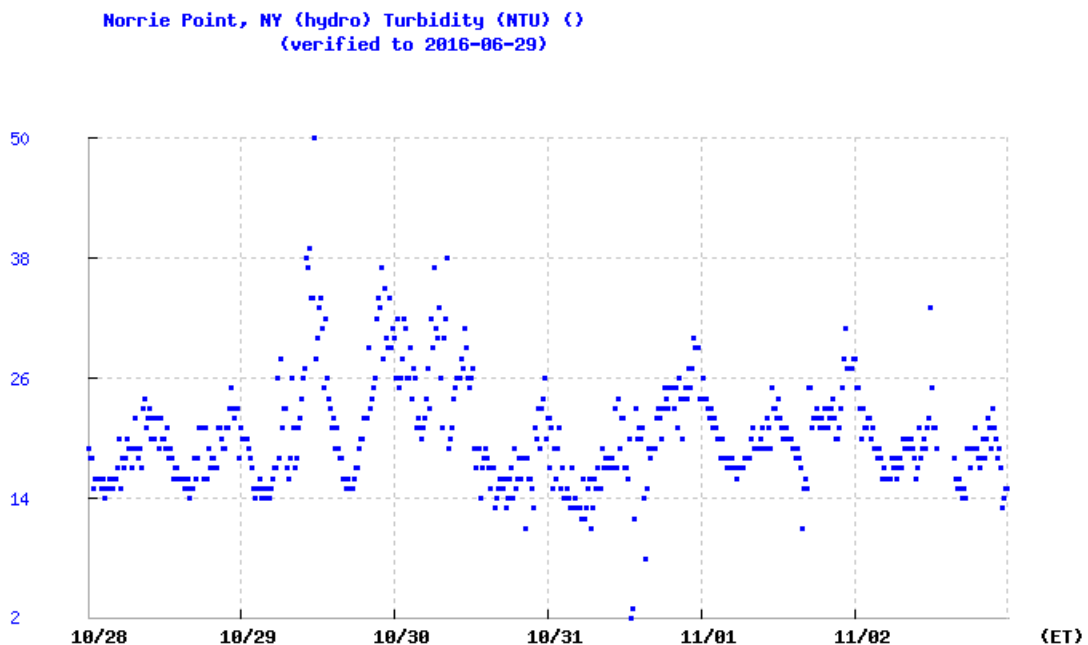
Bar graphs are easy to read to see an average.
8. How do your own group's data contrast with the average (this is called *variability*)? In other words, are your group data close to the average or do they vary greatly from one another? Why do you think this?
Student answers will vary. Students should pay attention to whether their individual data are close to the average or not – in statistics, if one data set has a lot of data that are far away from the mean, then the standard deviation will be much higher than another data set that has data which are closer to the mean (or, less variable).
9. If you wanted to repeat this experiment, explain what you would do to reduce the variability?
Students may refer to being more careful about counting organisms; picking only young Daphnia to ensure their survival; investigating different turbidity levels, etc.

10. Using the HRECOS website, look at the impact of two recent storms on turbidity in the Hudson River. We suggest using Hurricane Irene (August 26-September 3rd, 2011) and Tropical Storm Sandy (October 28-November 2nd, 2012) as good storms to observe. Tropical Storm Lee (August 30 – September 6, 2011) is another storm that shows dramatic changes. *These example data are from the Norrie Point hydrological station.*

This graph is from Hurricane Irene.

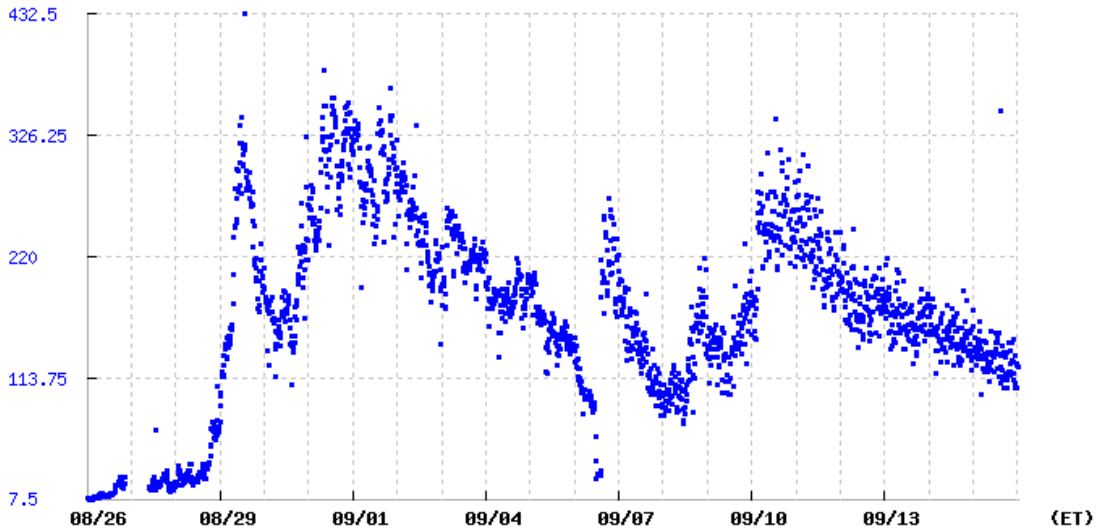


This graph is from Hurricane Sandy.



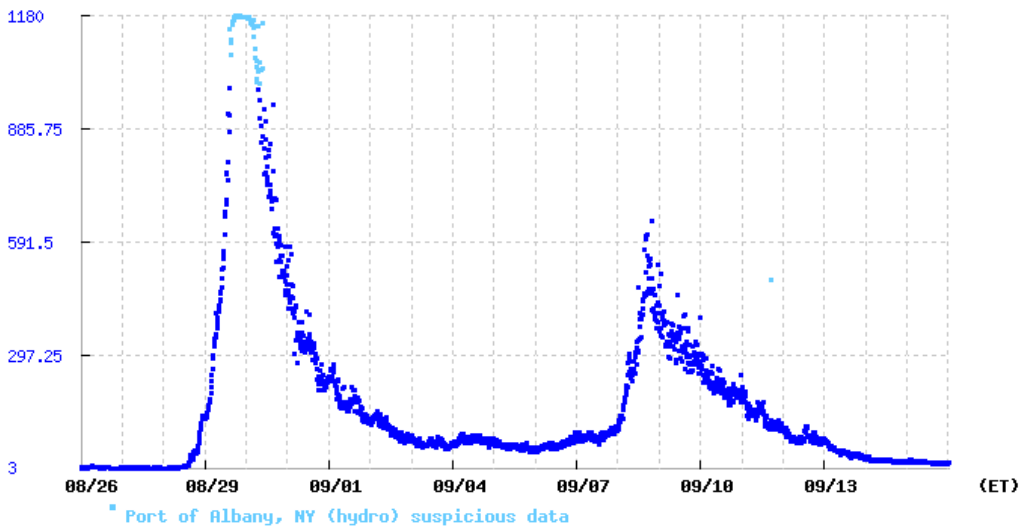
This graph shows both Hurricane Irene and Tropical Storm Lee.

Norrie Point, NY (hydro) Turbidity (NTU) ()
(verified to 2016-06-29)



For an interesting comparison, consider showing students how the turbidity values were different at the Port of Albany for Irene and Lee:

Port of Albany, NY (hydro) Turbidity (NTU) ()
(verified to 2016-04-01)



Port of Albany, NY (hydro) suspicious data

- a. What were the maximum turbidity levels for the storms?
 - i. Storm 1: *For Norrie Point, Hurricane Irene's maximum values were around 430 NTUs, while for Albany, the maximum values were around 900 NTUs.*
 - ii. Storm 2: *For Norrie Point, Tropical Storm Lee's maximum values were around 360 NTUs, while for Albany, the maximum values were around 600 NTUs.*

- b. Do you think these high levels of turbidity caused a problem for aquatic life in the Hudson River? Why or why not?
Students should discuss the high values but also the length of time it took for the river to "get back to normal". A spike lasting one or two days may kill some organisms, but it depends on the organisms. Students may also want to think about other factors that were at play during these storms, such as the high flow levels.

11. Based on what you've learned from this experiment, at what concentration of turbidity do aquatic organisms begin to respond? Are the turbidity levels found in the streams near the hydrofracking wells (which ranged from 1.9 to 10.1 NTUs) a problem? Why or why not?

Answers will vary based on the experimental results. However, students should discuss the fact that TIME is an important factor – how long do turbidity levels remain high? And how high? Some students may think about how different types of organisms are affected differently, and the fact that this experiment only looked at one organism.

