How Clear Is the Water?

Turbidity Activity Manual

(As a side note, if you have probe-ware, software, or other technology at your disposal, please feel free to modify and adjust the lessons as needed.)

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Lesson Overview

Hello! Thank you for downloading this lesson from the National Park Service website! I hope you find what you are looking for when you go through this with your students. A little background about this lesson before you get started; this lesson was created to allow you to modify and adjust as you see fit with your students. I have given the basic necessary steps, but if you have more advanced technology, please feel free to supplement that in. There are so many opportunities for students to get a hands on learning experience. My goal was to create a lesson that students could feel a connection to, actually take the learning and make it their own by putting more that just a class period into learning something that is required. My belief is that learning happens outside of just the required standards.

I created this lesson while I was out in the field working with the SWAN team at Lake Clark National Park. The gentlemen I was working with allowed me to participate in their study and ask as many questions as I could think of (which I took advantage of much to their surprise). Water quality is a very large portion of the work being done at Lake Clark. Scientists have been monitoring the water to, not only note fluctuations as the climate changes and the glaciers melt, but to also be able to identify factors that affect the fish populations. The work being done at Lake Clark National Park is at the forefront of the scientific world. They work hard to preserve their natural resources, identify problems, and keep the park as wild as can be. They also work closely with the Native population of Den'ina people who call Lake Clark home. The science here is a mixture of western technology meets Native understanding of the land to create some of the most well rounded studies out there.

Lake Clark National Park and Preserve hosts only a fraction of the guests many larger parks do, but the ones who visit are not disappointed. There are mountains to hike, lakes to kayak, rivers to pack-raft, and salmon spawning grounds to fish. Lake Clark NP is by far the outdoorsman or woman's dream. I hope that someday you will have the chance to visit one of the worlds last few remaining wild spawning grounds of sockeye salmon, take in the breathtaking views of the lake from the top of Tanalian mountain, and sit down and chat with village elders about the people who have always been.

Happy Teaching!!

Jessica Winn
Teacher-Ranger-Teacher
Lake Clark National Park and Preserve

Turbidity Lab

Problem*:* How clear is the water near my school?

Background Information: Plants, animals, and algae all need a certain amount of sunlight to penetrate the water in order to survive. Some can live in more turbid water where others need almost no turbidity in order to thrive and reproduce. Turbidity can be affected by a number of things ranging from glacial run off, rainstorms, human activity, and so on. Our job as ambassadors to the outdoor world should be to identify the amount of turbidity that the water in our area can manage and try to keep the water as turbid free as possible!

Please define the following terms to help you with the remainder of the lab.

Turbidity:
Water Quality:
pH:
Dissolved Oxygen:
Climate Change:

Hypothesis: Create a hypothesis about what you think will happen when we create Secchi disks and test them in the water near our school. Be sure it's in the proper format! Think in terms of turbidity and water quality.

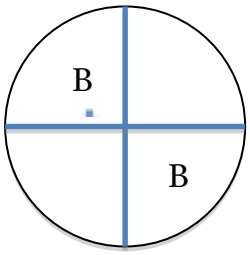
_____
_____
_____

Materials:

1. Pencil or Pen
2. Ruler
3. String
    i. One piece at least 26 cm (about 10 inches) long
    ii. One piece at least 2m long
4. Large white construction paper
5. Black colored pencils or pens or crayons (must be black, not grey!)
    i. Can substitute black construction paper and glue
6. Clear packing tape
7. Meter stick or metric tape measure
8. Thermometer

Procedure

Creating the Secchi Disk



1) Gather all materials
2) Take the large white construction paper and fold it in half horizontally then vertically. Try to make your folds as precise as possible to get the perfect lines. Flatten your paper and smooth out the creases. Place a pen mark at the center of your folds where the two lines meet; that will be the center of your circle.
3) Attach the smaller string around the tip of your pencil/pen. Place the string at the center of your circle. Measure, from the tip of your pencil 8inches or 25.4cm.
4) With your pencil, trace a circle that should have an 8inch radius on the white paper.
5) Because your paper should have crease marks, it should be divided into quadrants. Using your black colored pencil or construction paper, color every other quadrant, alternating black and white.
6) When you have a fully colored Secchi Disk, use packing tape to laminate your circle on both sides. Get the tape a smooth as possible so there are no bumps or ripples. You want it to lay flat.
7) Attach the long string to the center of your Secchi disk at the pen mark using tape to hold it in place.
8) Using tape, or a staple, attach the bottom of the meter stick or tape measure to the center of your Secchi disk.

At the water

9) Take your completed Secchi Disk out to the water with your data table.
10) Decide on several locations to lower your disk (at least 3 different areas) and get started. You should choose a location that looks slightly turbid and is deep enough to lower your disk in completely. (This might mean you have to walk into the water, so please be careful!) Record the general observations about each area.
11) Before you use your Secchi disk, take the surface temperature of the water and record that information on your data table.
12) Carefully lower the Secchi disk into the water (remember you want to keep your disk as flat as possible)
13) You are going to lower the disk until it disappears from sight (you can no longer see the disk) or until you have reached the end of your meter stick. Record the distance, from the top of the water (as flat as you can get it) onto your data table. Your measurement should be in cm.
14) Pull your Secchi disk up to where you can see it, lower it in the water again, and record. You will do this 4 more times for a total of 6 data points on your data table.
15) Move to the next lowering point and repeat steps 11-13. You will do this for all locations.

Data: Fill in the data chart below for all 3 locations. Be sure to record the general surroundings in your information and location!

Location:	Temperature:
General Observations about setting:	
Measurement 1 (in cm)	
Measurement 2	
Measurement 3	
Measurement 4	
Measurement 5	
Measurement 6	

Location:	Temperature:
General Observations about setting:	
Measurement 1 (in cm)	
Measurement 2	
Measurement 3	
Measurement 4	
Measurement 5	
Measurement 6	

Location:	Temperature:
General Observations about setting:	
Measurement 1 (in cm)	
Measurement 2	
Measurement 3	
Measurement 4	
Measurement 5	
Measurement 6	

Calculations: Find the average distance for each of the different locations. Record and show all your math!! Record results here in cm.

Location 1	Location 2	Location 3

Analysis: Based on your results, create a graph (on graph paper) showing all your data points. Then answer the questions that follow on a separate sheet of paper.

On your graph, be sure to include:

- Title
- X and Y axis titles
- Key
- 12 data points labeled and connected
- 3 clearly identified average points

1. Look over your graph; are there any points or recordings that surprise you? Explain why or why not.

2. Based on your location, where is the majority of the water coming from? Is there reason for the water to be turbid upon entering the area you sampled? Explain.

3. Things like increased glacial melt, hurricanes, and other natural disasters can cause a drastic change in turbidity. What types of things might cause a change in turbidity in your body of water?

4. Why might the temperature reading you took be an inaccurate representation of the body of water as a whole? Explain.

5. How might temperature affect the turbidity of water? (Think in terms of photosynthesis and photosynthetic action)

6. Explain how dissolved oxygen may have affected turbidity. Is there a reason for the dissolved water to have affected turbidity?

7. What kind of life does your body of water sustain? How might have the organisms adapted to live with the turbidity?

8. How might a change in turbidity affect the ecosystem of your body of water?

Conclusions: In a carefully written conclusion, accept or refute your hypothesis, explain your results, and analyze any errors you have encountered. If there were errors, identify how you could have avoided them or how you will correct them in the future.

Assessment: Secchi Disk Engineering

You have now gone through the process of creating your own Secchi Disk, testing it out, and seeing how it works. Your job will be to create and design your own Secchi Disk or use the standard Secchi Disk to solve a greater problem. This will lead to a formal lab write up, so be sure you are recording all of your information carefully. Follow the steps below to help you engineer your own disk.

1) Decide on a problem. We have a good Secchi disk that has been used for many years. How can we make that design better? If we don't want to make it better, how can we change the design to test for other things?

    a. Record your problem here:

    _____
    _____
    _____

2) Once you have a problem in hand that you are going to overcome, do your background research. Write down any and all information you deem necessary about the problem and what you are trying to achieve.

    a. Record your background information here:

    _____
    _____
    _____
    _____
    _____
    _____

3) Start brainstorming ideas. You should start out with a lot of ideas and brainstorms, evaluate each of those ideas, and choose your best fitted solution.

    a. What is your final solution for a product?

    _____
    _____
    _____

4) Create a prototype

    a. What are the steps to creating your prototype?

    _____
    _____
    _____
    _____
    _____
    _____

5) Test!

   a. What are the results to your test? How did you record them? Be sure you include what types of data tables you have incorporated!

6) Evaluate, redesign, retest

   a. This is the most important part of the engineering design, how are you going to evaluate your design? How will you make it better? How will you/what will you retest?

7) Conclusions and share?

   a. What did you find after several retests? How will you share that information?

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Assessment: Turbidity Lab Report

Based on the information you have worked with and through using the Turbidity Lab, your job is to write a formal lab report based on your findings. Please ensure that you have all parts of the lab report present, it is written in a third person perspective, and all grammar errors are fixed. The format should be as follows:

1) Identify the problem – 5pts
   a. What were you trying to understand or accomplish in your lab? What results are you trying to identify about the river/lake/pond/ocean that you are studying? Was there an issue you were trying to solve, a conclusion about habitat you were trying to make, or a reference you were creating?

2) Background information – 5pts
   a. Give background about the area, what is the life in the area (plant and animal), how long have you noticed the problem, previous research completed in the area, etc.

3) Hypothesis – 5pts
   a. A proper written hypothesis should have an if/then format. There should be a predicted solution for the problem you have previously identified.

4) List of materials – 5pts
   a. This should be a detailed list of materials to be used. If you use specific amounts of things, e.g. 5mL of water, in your lab, you should have that listed. The more information you give about

the materials the better. If an undefined amount is necessary, please identify the item only, e.g. water.

5) Procedure – 15pts
    a. This should be a very detailed list of steps used to gather data. The more specific the better. Remember, you are writing these procedures as if there was someone who had never done science before and wanted to try your experiment. Carefully document each step as you go through the process. If you create a base set of procedures then something happens and you change procedures, make sure you note that for your final lab write up.

6) Data collection – 15pts
    a. Any and all data you have recorded should be identified in clear and easy to understand data tables, graphs, and set points. If you have information that you are organizing, please identify where you will be organizing it.

7) Analysis – 20pts
    a. Any and all calculations should be kept in the analysis portion. If you have numerical data, please keep the information clearly written out and organized.

8) Conclusion and results shared – 20pts
    a. By far one of the most important steps in a lab report. Look over the data you have gathered, look over your analysis, look back through the steps you have taken to get to the results and draw conclusions about your research. Accept or refute your hypothesis with an explanation as to why you have reached that conclusion. Identify any errors that occurred while gathering data and explain them as operational or operator errors. Explain how you intend on sharing that information with the public, why it's important, and what the future may hold. You should also add in something about possible research opportunities in the future.